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RIBES VULGARE AND ITS INDIGENOUS REPRESENTATIVES IN EASTERN NORTH AMERICA.

M. L. Fernald.

The common Red Currant (*Ribes vulgare*) of our gardens has become well established along fence-rows, in roadside thickets, in open woods near towns, and in other places where its seeds have been easily spread, by birds and other agents, from the cultivated shrubs. In these half-wild habitats the plant has thus far shown little or no tendency to vary from the Old World type from which it was derived.

In low coniferous forests and mossy swamps and in subalpine districts of New England and eastern Canada, however, where the commonly cultivated European *Ribes vulgare* is as yet unknown, there are two indigenous red currents which have been passing as identical with or scarcely separable from the introduced plant of the gardens. These plants have several characters in common by which they are readily distinguished from the cultivated shrub. *R. vulgare* is usually upright, bearing numerous leafy tufts more or less mingled upon the old wood with the flower-bearing shoots. The blades of the mature leaves are 3.5 to 6.5 cm. broad, somewhat broadened upward, the lobes mostly short-ovate, the middle one rarely broader than long. The pedicels are mostly smooth and glandless, in one form only soft-pubescent. The rotate calyx is greenish-yellow, its oval lobes abruptly narrowed below the middle and the petals are narrowly wedge-shaped. At the base of the calyx, between the stamens and the slightly-cleft style, there is a high but narrow obtusely scalloped ring.[1]

[1] As recently shown by Professor Janczewski, two European species have been passing as *Ribes rubrum*. One, the true *R. rubrum* L., with its "*habitat in* Sueciae *borealibus*," has the calyx somewhat cup-shaped, brown or mottled with red and destitute of a disk. This species so far as known to the writer is not found wild in America. The other, *R. vulgare* Lam., with the flat calyx yellowish green and bearing a prominent disk, is the common species of cultivation. (See Edouard de Janczewski, Comp. rend. acad. franc., cxxx. 1890, 588; and Bull. Acad. Cracovie, Janvier, 1906, 3.)

In the indigenous shrubs of our northern forests and mountain-slopes the stems are decumbent or loosely straggling or reclining, often rooting freely where they touch the ground. The leafy shoots are produced chiefly from terminal buds while the numerous racemes appear below the leafy tips along the otherwise naked old wood. The blades of the mature leaves are 5 to 10 cm. broad, the sides nearly parallel, the lobes mostly broad-deltoid, the middle one usually broader than long. The pedicels are more or less covered with reddish or yellowish glands. The calyx is smoke-color or dull purplish, its segments very broadly cuneate, and the petals of similar outline. At the base of the calyx, between the stamens and the deeply-cleft style, there is a low and broad pentagonal disk.

In all their essential characters the indigenous shrubs are uniform, but while the plants of one region have the leaves bright green and glabrous or glabrate upon both surfaces, those of other localities are whitened beneath with tomentum. Whether this production of pubescence is due to peculiarities of the soil such as have been pointed out in the case of *Ribes oxyacanthoides*, var. *calcicola*[1] it is not now possible to state with certainty. It is, however, significant that the only phase of the plant known to the writer from the granitic mountains of Quebec and northern New England — Table-topped Mountain, Katahdin, the White Mountains, etc.— is the shrub with glabrous or glabrate leaves; plants from the humus of woodlands and swamps where the characteristic rock is more or less calcareous have the veins on the lower surfaces of the leaves somewhat ciliated with inconspicuous hairs — for example, specimens from low woods and Arbor-Vitae swamps in Rimouski County, Quebec, northern Maine and northern Vermont; and the shrubs which have unquestionably grown in strongly calcareous soils — specimens, for instance, from crevices of calcareous slates at Fort Kent and at Brownville, Maine — retain to maturity a soft coat of whitish tomentum. Most herbarium labels unfortunately give no information upon these points and further observations are necessary before we can state finally that the two extremes of our indigenous red current are due to local soil-conditions. Both in the field and in the herbarium the two plants are notably different in aspect, the one with quite green foliage, the other with the leaves strongly whitened beneath.

[1] Fernald, Rhodora, vii. 155 (1905).

The shrub with the leaves whitened and permanently tomentose beneath is the plant described by Pallas from northern Asia as *Ribes triste,* and later redescribed by Maximowicz as *Ribes rubrum,* γ *subglandulosum,* from Siberia, Mandshuria and the colder regions of America. The other, with the mature leaves glabrous or at most ciliate along the nerves beneath and green on both surfaces, is well matched by Michaux's material of his *R. albinervium* described from Canada ("ad amnem *Mistassin*"). The characteristics and distribution in eastern America of the smooth-fruited red currents may be briefly stated as follows:—

Ribes vulgare Lam. Suberect shrub: leaves mostly cordate, slightly pubescent beneath or glabrate; the mature blades 3.5 to 6.5 cm. broad, broadened upwards, 3–5-lobed, the lobes mostly short-ovate: racemes spreading in anthesis, drooping in fruit, 3 to 5 (becoming 7) cm. long: the rachis glabrous, though often glandular: the pedicels mostly glandless: calyx yellow-green; its segments oval and abruptly narrowed below the middle: petals narrowly cuneate: disk between the stamens and the slightly-cleft style a high narrow ring with round-scalloped margin: fruit plump and juicy.— Encyc. iii. 47 (1789); Janczewski, Compt. rend. acad. franç., cxxx. (1890) 588, and Bull. Acad. Cracovie, Janv., 1906, 3. *R. rubrum,* var. *sativum* Reichb. Fl. Excurs. 562 (1830). *R. rubrum,* most authors, not L. Common in cultivation and frequently escaped and established in fence-rows, thickets and open woods. Naturalized from Europe.

R. triste Pallas. Straggling or reclining, the branches often rooting freely: leaves somewhat heart-shaped, the mature blades 5 to 10 cm. broad, the sides nearly parallel, the lobes mostly broad-deltoid, permanently white-tomentose beneath: racemes drooping, 3.5 to 9 cm. long: pedicels mostly glandular: calyx smoke-color to purplish; the segments broadly cuneate or subrhombic, as broad as or broader than long: petals broadly cuneate: disk a low broad pentagon: style deeply cleft: fruit mostly small and hard.— Pall. in Nov. Act. Acad. Petrop. x. (1797) 378); Janczewski, Bull. Acad. Cracovie, Janv., 1906, 3. *R. rubrum* of many authors, not L. *R. rubrum,* var. *subglandulosum* Maxim. Bull. Acad. St. Petersb. xix. 261 (1874). Cold woods, swamps, and subalpine regions, Newfoundland to Alaska, south to Maine and Vermont, perhaps confined to regions of pronouncedly calcareous soil. Also in Siberia and Mandchuria.

Var. **albinervium** (Michx.) Similar, but with the leaves glabrous or sparingly pubescent beneath when young, soon glabrate. *R. albinervium* Michx. Fl. i. 110 (1803).— More common, extending south to Nova Scotia, central New Hampshire, southern Vermont, Michigan, Wisconsin, etc.

GRAY HERBARIUM.

CONNECTICUT RUBI.

WM. H. BLANCHARD.

THIS paper presents some of the facts obtained and conclusions reached by me during ten weeks spent in Connecticut searching out and studying its Rubi, more especially its blackberries. Visits of a week or more each were made in August, 1903, in July, 1904, and in June and August, 1905; and five weeks in June, July, August and September, 1906, were devoted to the work. Southington and Plainville were pretty thoroughly searched and much was done in the surrounding towns especially in Bristol, New Britain, Newington, Farmington, West Hartford, Berlin and Wethersfield. Trips were taken to New London and Norwich, Stamford, Winsted, and Somers, and numerous shorter ones were made. Mr. C. H. Bissell and Mr. Luman Andrews of Southington, Mr. W. B. Rossberg of New Britain and Dr. C. B. Graves of New London very kindly aided by visiting localities with me and exhibiting specimens.

RUBUS OCCIDENTALIS L. Black Raspberry. Abundant in all parts of the state. It probably thrives no better anywhere than in Connecticut, which is far enough south for it to be at home on the highest land. The fact does not seem to be generally known that this is a comparatively southern species and is found in Northern New England like the white oak and white pine only in favored places, occurring rarely in the high or northern parts.

R. STRIGOSUS Michx. Red Raspberry. Abundant in all parts of the state. While *R. occidentalis* is a comparatively southern plant, *R. strigosus* is a northern plant and it fruits very poorly in Connecticut.

R. NEGLECTUS Peck (*R. occidentalis* × *R. strigosus* Austin). Purple Raspberry. This occurs occasionally and is easily recognized when ripe. It may be briefly described as a red raspberry growing on a black raspberry bush. The fruit is soft and loosely held together like the red raspberry, but there is enough black mixed with the red in its color to make it purple. The cane is long and recurved and it tips as readily as the black raspberry. Careful examination shows that in all its characters it is an intergrade between *R. occidentalis* and *R. strigosus* and I have never failed to find both of them growing with or near it. It seems probable, however, that such proximity of the parent species is not without exception.

R. ODORATUS L. Flowering Raspberry. Mulberry. Occasional in most parts of the state but nowhere common. Rare in the southeastern part, frequent in some sections in the southwestern part. It seems to prefer rocky woods and thrives among the loose stones at the foot of ledges, but is sometimes seen in fence-row hedges in cleared land.

R. TRIFLORUS Richardson. Rare in some places but generally distributed. Prefers damp swampy woods.

R. CUNEIFOLIUS Pursh. This species, very distinct and agreeably constant in its characters, occurs in no other New England state. Its dwarf growth and numerous strong hooked prickles make the name "ankleberries" very appropriate. In southern New Jersey I found it called "hog blackberry." The fruit is cylindrical, large and fine-flavored. Here it is not confined to sandy soil. East of the Connecticut River it is known to occur in but one section, namely, the towns of Chatham, Colchester and Portland. West of the Connecticut River it has been found as far north as Farmington and as far east as Guilford. It seems to be occasional in some places and frequent in the southwestern quarter of the state.

R. ALLEGHANIENSIS Porter. (*R. nigrobaccus* Bailey.) Sow-teat Blackberry. This is *the* high blackberry here and is abundant nearly everywhere. No other blackberry has such a delicious, spicy, aromatic taste, and no other of all our wild berries except the strawberry approaches it in excellence. Its great number of drupelets makes it very seedy. Its long, slender, tapering shape has suggested its two most characteristic names — Sow-teat and Sheep-teat.

Odd forms of this species turn up everywhere. They seem to be local mostly. Dr. Graves very kindly took me to the station where

R. nigrobaccus, var. *Gravesii* Fernald grows. In its immediate vicinity good normal plants were seen. This variety from its yellow color, poor fruit and general sickly appearance seems to be a pathological variation. If these plants were removed to a more favorable home, it seems probable that they would soon be normal.

R. Andrewsianus Blanchard. Rhodora viii. 17 (1906). Abundant near the sea, in the river valleys and on the sand plains. In these parts of the state it largely takes the place of *R. Alleghaniensis*. It is a southern species reaching its northern limits here, where it seldom bears a good crop; but in southeastern Pennsylvania, Maryland and Virginia, where it is the common high blackberry, the crop is abundant. The berries are very large and are not "seedy." Many of them are much higher than broad; they are always loose-fruited, with large "grains" or drupelets.

R. floricomus Blanchard. Am. Bot., Nov., 1905. The area on which this species is known to grow is the southeastern part of Southington and on Meriden Mountain. It is distinct enough and covers sufficient territory to make it probable that it will be found in other places.

R. frondosus Bigelow. Probably occasional throughout the state and frequent in some places. Discussed in Rhodora, Nov., 1906. Stations found: Southington on the New Britain pipe-line, 100 rds. east of Queen St., July, 1904, a single plant; Plainville at the railroad overpass, August, 1905, a small clump; 1906, Plainville at White Oak, Southington at Shuttle Meadow, Farmington at the bridge and reservoir, West Hartford, Rocky Hill, near Norwich, and abundant on Cedar Hill near the southeast corner of Cedar Hill Cemetery in the northwest corner of Wethersfield.

R. procumbens, Muhl. (*R. Canadensis* Gray's Manual. *R. subuniflorus* Rydberg). Running Blackberry, Dewberry. Common throughout the state. This species presents numberless forms some of which resemble *R. invisus* Bailey and *R. Baileyanus* Britton, two species of dewberry whose status is uncertain at present. *R. subuniflorus* Rydberg seems to be a decumbent, depauperate form of *R. procumbens*. There is little that is constant in most of the forms of this species and what final disposition of them botanists may make is problematical.

R. recurvans Blanchard. Rhodora vi. 223 (1904) and viii. 152 (1906). Frequent, often abundant, in Central Connecticut and

probably found throughout. A form with thicker dark green leaves also occurs whose status is still uncertain.

Rubus Rossbergianus, n. sp. Plants glandless, pubescent, 1 to 2 feet high, stems large at the base, recurving, 3 to 5 feet long, the prostrate end often tipping; prickles of moderate size. Leaves large, dark green, rather thick, 5-foliate; leaflets broad, those on old canes remaining till fall. Inflorescence cymose, pedicels subtended by narrow leaves; flowers large; fruit short-cylindrical ½ in. high, productive.

New canes. Stems erect at first, 1 to 2 feet high, hard, green, terete, glabrous and glandless, often branched, soon recurving, becoming 3 to 5 ft. long, often tipping. Prickles ⅛ to $\frac{3}{16}$ in. long, slender, straight, strong, slanted slightly backward, numerous, 20 to the inch of stem, not noticeably in lines. Leaves large, the earlier 6 to 7 in. long by 5 to 6 in. broad, later leaves smaller, rather thick, 5-foliate, dark green with appressed hairs on the upper surface, lighter beneath and very pubescent. Leaflets broad, outline entire, long taper-pointed, finely and doubly serrate-dentate; the middle leaflet very broad and cordate, the side leaflets broad and ovate or oval, the basal leaflets broad and cuneate at the base. Petiole and petiolules large, glabrous, grooved, prickles numerous, short and hooked; the petiolule of the middle leaflet 1 in. long, the side ones one-third as long and the basal leaflets sessile.

Old canes. Stems hard, greenish brown, badly killed back, prickles intact. New growth consisting of short leafy branches mostly bearing inflorescence, one to four from each old leaf-axil, 3 to 6 in. long. Axis zigzag, slightly pubescent, prickles few, hooked. Leaves one to three, trifoliate on the main axis, and numerous unifoliate leaves above on the inflorescence making it rosette-shaped. Leaflets and unifoliate leaves mostly narrow, occasionally broad, coarsely serrate-dentate and toward the points deeply dentate; in color, texture and pubescence like those on new canes. Inflorescence cymose, axis short, about 8-flowered, the pedicels subtended by unifoliate leaves. Flowers appearing June 15 or earlier 1¼ to 1½ in. broad, petals oval, one-half as wide as long. Fruit ripening very early short-cylindric, about ½ in. high, composed of large drupelets. Edible, sweet and sought by berry-pickers. Leaves persisting till fall.

Type station: Southington, Connecticut, 25 rods southeast of the junction of Lazy Lane and Queen Street. Abundant in Southington

and the surrounding towns. Equally typical plants are abundant in Manton, Graystone and Graniteville near Providence, Rhode Island. Fairly representative plants were also seen in Canton, Lexington and Palmer, Massachusetts.

This plant can be placed with the *Recurvans* class, and in appearance it is intermediate between *R. recurvans* and *R. procumbens*. It differs from *R. recurvans* in having thicker and dark green leaves, green stems, a more prostrate habit, and the rosette-shaped collection of unifoliate leaves subtending the pedicels is very noticeable.

Mr. W. B. Rossberg, whose name is associated with this species, is a well-known local botanist of New Britain, Connecticut, who is also an enthusiastic student of local geology.

R. SETOSUS Bigelow. (*R. nigricans*, Rydberg). Frequent in moist situations, borders of swamps, ponds and streams and sometimes in dry ground. Described fully in RHODORA, Nov., 1906.

Rubus semisetosus, n. sp. Plants decumbent or erect, stems mostly round, hard, glandless, with numerous slender, often reflexed bristle-prickles; leaves on new canes 5-foliate, narrow-ovate, approaching obovate, rather long-pointed; fruit poor; flowers appearing late.

New canes. Stems decumbent or erect, 1 to 3 feet long generally terete, reddish, hard, glabrous and glandless, rarely branched. Prickles numerous, 20 to 30 to the inch of stem, the slender or bristle-shaped prickles often $\frac{3}{16}$ in. long, perpendicular to the stem or more often very retrorse. Leaves of moderate size, $3\frac{1}{2}$ to 5 in. wide, 5-foliate, not thick but firm in texture, dull green and nearly glabrous on the upper surface, paler and more or less pubescent below. Leaflets oval or often appearing obovate, rather long taper-pointed, outline entire, serrate and serrate-dentate, more or less doubly; the middle one about twice as long as wide, often rounded at the base, the others much narrower and cuneate. Petiole and petiolules grooved, nearly glabrous; slender bristle-prickles weak and retrorse; petiole long; the petiolule of the middle leaflet $\frac{3}{4}$ in. long, those of the side leaflets one-third as long and the basal leaflets sessile.

Old canes. Stems mostly decumbent, often prostrate, much killed back, prickles greatly impaired. New growth consisting entirely of leafy fruit-branches 4 to 6 in. long tipped with inflorescence, one from each old leaf-axil. Axis zigzag, somewhat pubescent, bristles few. Leaves 3-foliate or rarely a few 5-foliate, few unifoliate, leaflets narrow; in color, texture and pubescence much like those on new

canes. Inflorescence a short raceme; pedicels slender, pubescent, often branched; bearing as well as the calyx a few glanded hairs or weak bristles, one or both or neither. Flowers most often appearing late, about 1 in. broad, petals long and narrow, two or three times as long as wide. Fruit poor, of a few drupelets, or sometimes maturing as fine globose berries ½ in. in diameter.

Type station: The sand plains of Plainville and Southington, Connecticut. An abundant plant in Southern New England, growing mostly on dry ground and especially on sandy soil.

This plant is readily distinguished from *R. setosus* Bigelow into which it probably intergrades by having hard stems with comparatively few bristles and no glands, and in having the inflorescence nearly naked, the leaves, fruit and flowers on each being much alike.

Rubus ascendens, n. sp. Plants erect, 2 to 4 feet high, sometimes branched, angled; prickles numerous, rather strong; glandless or with a few glands on the inflorescence; leaves on new canes 5-foliate, often upward-turned; leaflets long-pointed, ovate or oval; flowers late; fruit small, often valuable.

New canes. Stems erect, 2 to 4 feet high, generally angled, green or reddish, hard, glabrous and glandless, often branched. Prickles numerous, 15 to 20 to the inch of stem, slender and spiny or strong bristle-prickles, often $\frac{3}{16}$ in. long with a slight backward slant. Leaves often large, 5-foliate, of firm texture, dark yellow-green and nearly glabrous on the upper surface, paler and somewhat pubescent, often quite pubescent below. Leaflets ovate or oval, often broad, long taper-pointed, outline entire, serrate or serrate-dentate; the middle one widest and rounded often cuneate at the base, the others narrower and cuneate. Petiole and petiolules large, grooved, slightly pubescent with slender retrorse prickles, the petiolule of the middle leaflet about ¾ in. long, the side leaflets short-stalked and the basal ones sessile.

Old canes. Stems green or green-red, prickles little impaired. New growth consisting of leafy fruit branches, 4 to 12 in. long generally one from each old leaf-axil. Axis of branch zigzag, slender, weakly armed, nearly glabrous. Leaves 3-foliate below, the upper unifoliate; leaflets wide or narrow, in color, texture and pubescence like those on new canes. Inflorescence a short raceme; pedicels slender, pubescent, otherwise naked or on many plants clothed with more or less weak bristles or glanded hairs one or both, with or without subtending unifoliate leaves or bracts. Flowers appearing rather

late, 1 in. broad or often broader, petals narrow, twice as long as wide. Fruit very variable, often consisting of a few drupelets, frequently bearing profuse edible fruit, which is globose, ⅜ in. or over in diameter.

Type station: Southington, Connecticut, twenty rods west of the railroad bridge over the Qunnipiac River near the Plainville line. Abundant in Southington, Bristol, Plainville and neighboring towns and in Southern New England generally.

This species is intended to include not only the plants which closely resemble the type, but also many others which cannot be placed with any species yet described. They are too large, strong, erect, and fruitful as well as too strongly armed to be placed with *R. semisetosus*. These characters and the general appearance of the new canes indicate the relationship of these plants to the high blackberries especially to small forms of *R. Andrewsianus*.

R. HISPIDUS L. Common. The delicate forms predominate, though some peculiar ones occur. A careful examination would probably lead to the discovery of a great number.

Most of the Connecticut Rubi are included in the above enumeration but in nearly all localities odd forms are to be found that cannot easily be placed. Many of them seem to have no second station. Of the peculiar tall forms some have considerable resemblance to *R. Canadensis* L. and *R. pergratus* Blanchard but both of these species are rare so far as known, though there are considerable areas in the northeastern and northwestern parts of the state which botanists have examined but little where the plants in question may occur in greater number and be nearer normal.

WESTMINSTER, VERMONT.

NOTES ON CONNECTICUT PLANTS.— *Phaseolus perennis*, Walt. This species, which was lost sight of by our Connecticut botanists for many years, has been reported in recent volumes of RHODORA from three stations in the southwestern section of the state. Two of these stations are near the borders of salt marshes, while the third is adjacent to a "scarcely brackish" marsh. A new station, discovered by me Sept. 28, 1906, in the town of Franklin, is of interest as showing the species growing under different conditions, and also as extending its range sixty miles farther toward the east. This station is twenty

miles inland from Long Island Sound, and just below the brow of a hill which rises to an elevation of five hundred feet above the sea level. Here in a sheltered, sunny location, along the base of a low cliff, the plant has found a congenial home and exhibits great vigor of growth, many of the racemes being fifteen inches in length. The station follows the line of the cliff for several rods.

Hierochloe borealis, Roem. & Schultes. In Connecticut this is essentially a species of the coast, and it is seldom found elsewhere. It occurs, however, in several bogs and meadows in Franklin, and it is abundant in one of them. These stations are noteworthy from being twenty miles back from the coast, in a typical hill town. Specimens gathered here do not differ noticeably from those collected in saline situations. In Rhodora vi. 104, this species is reported from Willoughby, Vermont, where it is said to be rare.

Eatonia Dudleyi, Vasey. This species appears to be better represented in southern Connecticut than has been supposed to be the case. In Rhodora vii. 68, I called attention to its frequent occurrence about New Haven. It is equally frequent in southeastern Connecticut. On several tramps last June through Franklin and adjacent towns, I found it in nearly every locality where one would naturally look for *Eatonia*, and it was often the prevailing species of this genus. It is not wholly confined to woodlands, for it grows in profusion in one place beside the New London Northern Railroad, where there is absolutely no shade, the trees having been cut away several years ago. The plants at this station are robust and very pubescent.

Cuscuta compacta, Juss. This species grows along all the principal streams of Franklin, and is by no means rare here.— R. W. Woodward, New Haven, Connecticut.

NEWLY OBSERVED STATIONS FOR MASSACHUSETTS PLANTS.

C. H. Knowlton.

During the past season I have made many botanical excursions in various directions from Boston, with some very interesting results. Messrs. William P. Rich and H. A. Purdie have been my companions on several of these trips, and the plants mentioned below are all represented by specimens in my herbarium, while many are also in

the herbarium of Mr. Rich. The following plants seem particularly worthy of mention:

Eragrostis minor, Host. This introduced grass is very abundant in the crevices and along the inner edge of the sidewalk, on Chandler Street, Boston, near Castle Square. I also collected it on the Centralville dump in Lowell, in 1902.

Allium tricoccum, Ait. I discovered the foliage of this plant in May, 1906, in rich moist woods by Clematis brook, Waltham, near *Asplenium acrostichoides*, Sw. When I revisited the station on July 7 the leaves had withered and the flower-buds were beginning to open. There were hundreds of plants, and the large round heads of white blossoms were very conspicuous. The plant has also been collected in the neighboring Beaver Brook Reservation, by Mr. R. A. Ware.

Allium vineale, L. I found a few plants of this species in the edge of a cultivated field on Rag Rock, Woburn. It is to be hoped that this pest will not prosper here, but remain an unusual plant.

Quercus Prinus, L. A few trees grow in sandy soil on the shore of Little Quittacas Pond in Lakeville. It is very abundant in Sutton, Worcester county, where it is the predominant tree in the woods around Purgatory Chasm. It is also frequent in Webster and Dudley, but I have not seen it near Boston.

Celtis occidentalis, L. Several trees grow in a pasture in Waltham, near Waverley. I found them first before the leaves came out, and visited them again the last of May, just as they were going out of blossom. The leaves and twigs seemed much diseased from the work of insect parasites. Small trees in better condition grow on Mt. Tabor in Lincoln (*C. H. Knowlton and E. L. Shaw*).

Nasturtium sylvestre, R. Br. This rare crucifer is very plentiful around a green-house in Natick, where it seems thoroughly established.

Potentilla fruticosa. L. One bush I have seen in a grassy swamp in Woburn, another larger in a similar place in Amesbury. In the northern part of Groton it grows in great profusion. This station was given by Mr. C. W. Jenks in the Middlesex Flora.

Amphicarpaea Pitcheri, T. & G. I found this growing in considerable abundance at Oak Island, Revere, where it was collected by Mr. Rich in 1893. (Rhodora, i. 27.) In general appearance as well as in several minor details it is distinctly different from the common species. Later in the season it was found by Mr. H. H. Bartlett in great abundance on Horn Pond Mt. in Woburn, only a mile or two from Mr.

Rich's original station in Winchester. Mr. M. L. Fernald also reports it from Rhode Island. (RHODORA, viii. 221).

Apios tuberosa, Moench. Mr. Rich and I found very many fine fruiting specimens of this common plant along the shores of Lake Monponsett, Halifax. Its usual mode of reproduction seems to be by rootstocks and tubers.

Desmodium cuspidatum, T. & G. In open woods, Horn Pond Mt., Woburn; also in moist oak woods, Natick.

Desmodium sessilifolium, T. & G. This plant, occasional in Connecticut and Rhode Island, was first reported in Massachusetts from Middleboro by William Boott (1870), and from Lakeville in 1871. The Lakeville station was visited in 1899 by members of the New England Botanical Club, and again this year by Mr. Rich and myself. The plant is still abundant at this place, along the dry sandy roadside near Lake Assawompsett. We also found a clump of very large specimens in an old orchard two or three miles away, and a large quantity further south, along the causeway between Little and Great Quittacas ponds, in Rochester. The fruit of this species sticks even closer than that of the common kinds, and further search would probably show that the plant is well distributed over this flat sandy region, where it finds its northeastern limit. Mr. John Murdoch, Jr. tells me it is still abundant at Middleboro.

Ilex opaca, Ait. A few good trees grow in the woods at Halifax, but no fruiting specimens were observed.

Viola arenaria, DC. I found an abundance of this in a dry clearing in Ashburnham, Worcester county. I have never seen it in the Boston region.

Viola sagittata, Ait. Abundant in moist sandy field, Kendal Green, Weston. Also in a similar situation near Cambridge reservoir, Lincoln. (*C. H. Knowlton and E. L. Shaw.*)

Aralia trifolia, Dec. & Planch. Moist woods, Burlington. Tophet Swamp, Lexington.

Hydrocotyle umbellata, L. This plant, so abundant on Cape Cod, seems even more plentiful in the northern part of Plymouth county. Messrs. Rich, Purdie and I found the submersed form in abundance at Indian Head Pond, Hanson. In Lakeville, at Little Quittacas Pond, where the water had been drawn off we found a belt some three rods wide of the terrestrial form, nearly surrounding the pond. The rootstocks formed an interlacing network, and one shore had

been plowed for nearly half a mile to destroy this plant and the few others which grew with it.

Chiogenes serpyllifolia, Salisb. A small station in the Hanson cedar swamp. (*C. H. Knowlton and R. A. Ware*).

Leucothoe racemosa, Gray. I have found one bush by the Charles River in Natick. It is abundant in wet woods at Halifax.

Hottonia inflata, Ell. The latter part of June Mr. J. W. Huntington of Amesbury showed me the station for this plant which he reported in Rhodora, iii. 216. July 7 I found a few plants in a small brook in Waltham, and the next day I came across large quantities in the ditch beside the Willow Road, Belmont.

Lysimachia producta, Fernald. There is a fine colony of this on the sandy shore of Silver Lake, Halifax.

Sabbatia chloroides, L. Large quantities of this in Halifax bring the plant a little nearer to Boston than previous reports.

Asclepias obtusifolia, Mx. This plant, reported "not common" in the Middlesex Flora, is frequent in the towns of Chelmsford, Westford, Dunstable, Groton and Tyngsboro, where the light glacial gravel favors it.

Echinospermum Lappula, L. Abundant in roadside thicket, Groton; roadside, Winchester.

Linaria genistaefolia, Mill. I found a single plant of this rare waif, in good fruit and flower, on a railroad embankment in Groton. I do not know of any other station in New England.

Scrophularia leporella, Bicknell. I discovered a large clump of this well fruited, growing alone in a dry pasture at East Lexington, August 4.

Scrophularia Marilandica, L. There is a fine station for this on Concord Hill, Lexington, from which I collected good fruiting specimens Oct. 13. It was found here as early as 1903 by Miss E. L. Shaw. This place and Oak Island are the only stations known for it in the Boston region.

Galium boreale, L. I found some fine plants of this by a ditch in a mowing field, near Central Square, Woburn. It grew with all the assurance of a native, and there was no evidence of its being a garden escape.

Bidens comosa (Gray) Wiegand. Wet roadside, Warren, Worcester county.

Matricaria discoidea, DC. I found a fine specimen of this in

Winchester early in the summer. Mr. F. G. Floyd has also a station for this peculiar-smelling "pineapple weed" in West Roxbury.

Solidago sempervirens, L. Abundant in an open grassy swamp in Winchester, at an elevation of about 200 feet. I have also collected it on the East Lexington meadows.

Boston, Massachusetts.

THE VARIATIONS OF PRIMULA FARINOSA IN NORTHEASTERN AMERICA.

M. L. Fernald.

Primula farinosa in its broad sense is a plant of very wide range, the typical form occurring in northern and mountainous districts of Eurasia and North America, while some representative of the species is found in nearly all cooler parts of the globe, even in Antarctic South America. The plant of eastern North America is very generally called true *P. farinosa,* and in Engler's Pflanzenreich nearly all the American plants are united by Pax and Knuth with the Eurasian plant as *P. farinosa,* subsp. *eufarinosa* Pax, var. *genuina* Pax.[1] As shown in the Gray Herbarium, however, there is very little American material which is clearly identical with the Eurasian type of *P. farinosa.* Instead, most of the material from the northeastern United States and adjacent British America is of two seemingly endemic varieties, while in the Rocky Mountains is a third which may be looked for with some confidence on the mountains of eastern Quebec. These three varieties and the Eurasian type of the species may be distinguished as follows.

* Calyx in anthesis 3–5 mm. long; involucral bracts 3.5–6 mm. long.

P. farinosa L. Low, rarely 3 dm. high: leaves oblanceolate to narrowly obovate, *white-farinose* beneath: bracts lance-attenuate: *pedicels rarely equalling the calyx*: capsule 6–8 mm. long, slightly exserted.— Sp. i. 143 (1753).— Eurasia. Rare in America: examined only from Labrador and Newfoundland.

Var. americana Torr. Scape 1–2.5 dm. high: leaves oblanceolate

[1] Pax & Knuth in Engler, Pflanzenr, iv. Fam. 227, 83 (1905).

or spatulate, rather stiff, covered beneath with *sulphur-yellow* powder: bracts as in the species: *pedicels elongate,* often 2 to 5 times as long as the calyx: capsule 5–8 mm. long, much exserted.— Fl. i. 213 (1824). — Shores of Lakes Huron and Michigan, Ontario and Michigan.

* * Calyx in anthesis 6–8 mm. long: bracts 6–11 mm. long.

Var. **macropoda**, var. nov. Planta 1–4.5 dm. alta; foliis spathulatis vel anguste rhomboideo-ovatis longe petiolatis, subtus farinosis; bracteis lineari- vel lanceolato-attenuatis; pedicellis elongatis (1–5 cm. longis); capsulis 9–12 mm. longis exsertis.

Usually tall (1–4.5 dm. high): leaves from spatulate to narrowly rhombic-ovate, long-petioled, usually white-farinose beneath: bracts linear- or lance-attenuate, often involute in drying: pedicels mostly elongate (1–5 cm. long): capsule 9–12 mm. long, usually much exserted.—Labrador, Battle Harbor, July 18, 1891 (Bowdoin College Exped. no. 104): Quebec, Island of Anticosti (Pursh); wet limestone cliffs, Percé, August 17, 1904 (*Collins, Fernald and Pease*); banks of the St. Lawrence R., Matane, August 7, 1904 (*F. F. Forbes*); limestone cliffs and ledges, Bic, July 16, 1904 (*Collins & Fernald*), July 6–10, 1905 (*Williams, Collins and Fernald*), July 5, 1906 (*Fernald & Collins,* no. 243 — type): Nova Scotia, without locality (MacCulloch); dripping cliffs, Baxter's Harbor, July 10, 1900 (*F. G. Floyd*): Maine, Mt. Kineo, August, 1866 (*A. H. Smith*), September 27, 1887 (*G. G. Kennedy*): Keewatin, a small green-leaved extreme, below high-water mark, shore of Hudson Bay, latitude 56°, August, 1886 (*J. M. Macoun*): Saskatchewan, Carleton House (*Richardson*): Athabasca, "The Cascade," Athabasca R., June 15, 1892 (*Elizabeth Taylor,* no. 38): Mackenzie, Great Slave Lake (*Richardson*).

Var. **incana** (M. E. Jones), n. comb. Scapes 1–3.5 dm. high: leaves oblong- to narrowly rhombic-ovate, short-petioled or subsessile: bracts linear-lanceolate, obtuse or acutish: pedicels in anthesis mostly shorter than the bracts, in fruit slightly elongated (rarely 2 or 3 cm. long).— *P. incana* M. E. Jones, Proc. Cal. Acad., Ser. 2, v. 706 (1895). *P. americana* Rydberg, Bull. Torr. Cl. xxviii. 500 (1906).— Rocky Mts., Alberta to Colorado and Utah.

Gray Herbarium.

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NOTES ON MUHLENBERGIA.

F. Lamson-Scribner.

A critical study of eastern species of *Muhlenbergia* as represented by the material in the National Herbarium, has led to a somewhat new classification of the species heretofore recognized and the segregation of several subspecies and one new species. The results of this study are here presented.

Section 1. Glumes minute, the first sometimes obsolete. *Muhlenbergia* proper.

1. Muhlenbergia Schreberi Gmel. Syst. Nat. **2**: 171. 1791. *M. diffusa* Willd. Enum. **1**: 81. 1809; Schreb. Gram. **2**: 143. Pl. 51. 1810.

1a. Muhlenbergia Schreberi **curtisetosa** Scribn. n. subsp. Panicles 3–12 cm. long; spikelets 2.5–3 mm. long; glumes unequal, the first ovate, obtuse, about 1 mm. long, the second ovate or ovate-lanceolate, obtuse, acute or abruptly mucronate-pointed, 1–2 mm. long; lemmas short-awned; awns 1 mm. or less in length. Type collected by J. Wolf in Illinois in 1881. Other specimens in the Natl. Herb.; Illinois, *J. Wolf*, 1882, Champaign, Illinois, *G. P. Clinton*, 1892. No. 204 *A. Commons* from Centerville, Delaware, apparently belongs here.

1b. Muhlenbergia Schreberi **palustris** Scribn. n. comb. *Muhlenbergia palustris* Scribn. U. S. Dept. Agric. Div. Agros. Bul. **11**: 47. 1898. Culms filiform; sheaths naked at the throat; both glumes manifest; awns 5–6 mm. long. Swamps, Brightwood, District of Columbia (Type locality).

Section 2. Glumes ovate, acute, much shorter than the lemmas. (*Stenocladium* Trin. Fund. Agros. 117, as a section of *Trichochloa*.)

2. Muhlenbergia sobolifera (Muhl.) Trin. Gram. Unifl. 189.

Pl. 5, fig. 4. 1824. *Agrostis sobolifera* Muhl. in Willd. Enum. 95. 1809. *Trichochloa sobolifera* Trin. l. c.

2a. Muhlenbergia sobolifera **setigera** Scribn. n. subsp. Culms very slender, much branched; lemmas awned; awns 1–3 mm. long. Otherwise as in the species. Type, no. 70 *J. Reverchon*, Texas, in Natl. Herb. No. 1054 *J. Reverchon* in Natl. Herb., also from Texas, belongs here.

3. Muhlenbergia tenuiflora (Willd.) B. S. P. Prelim. Cat. Pl. N. Y. 67. 1888. *Agrostis tenuiflora* Willd. Sp. Pl. **1**: 364. 1797. *Muhlenbergia Willdenowii* Trin. Gram. Unifl. 188. 1824. *Trichochloa longiseta* Trin. Fund. Agros. 117. 1820.

3a. Muhlenbergia tenuiflora **variabilis** Scribn. n. subsp. Culms smooth at the nodes, much branched above; panicles linear, strict, erect, more rigid than in the species; spikelets 4 mm. long; lemmas mucronate or short-awned; awns 2–3 mm. long. Type, no. 654a *Biltmore Herbarium* from Chimney Mountain, Rutherford, North Carolina, distributed as *Muhlenbergia sobolifera.*

Section 3. Glumes narrow, acuminate or aristate, nearly as long as or exceeding the lemmas in length. (*Acroxis* Trin. Fund. Agros. 117, as a section of *Trichochloa.*)

4. Muhlenbergia mexicana (Linn.) Trin. Gram. Unifl. 189. 1824. *Agrostris mexicana* Linn. Mant. **1**: 31. 1767. *Trichochloa mexicana* Trin. Fund. Agros. 117. 1820. *Muhlenbergia polystachya* Mac. & Bush. Trans. Acad. Sci. St. Louis, **12**: 79. Pl. 12. 1902. *Agrostis lateriflora* Michx. Flor. Bor. Am. **1**: 53. 1803. Culms diffusely branched throughout from the base; panicles numerous, 3–10 (usually about 6) cm. long, oblong-ovoid or subpyramidal, rarely linear, the base usually enclosed within the subtending leaf-sheath.

4a. Muhlenbergia mexicana **commutata** Scribn. n. subsp. Lemmas awned; awns 4–10 mm. long. Otherwise as in the species. (*M. sylvatica,* in part of authors.) Quite distinct from *Agrostis sylvatica* Torr. upon which *Muhlenbergia sylvatica* was based. Specimens in Natl. Herb.: no. 171 *M. L. Fernald*, 1893 and nos. 528, 1894 and 522, 1896, all from Maine; no. 80 *Wm. Harriot*, 1901, from Ontario and no. 26,245 *J. Macoun*, 1901, from the same region. Other specimens from New York, Delaware, Pennsylvania, Illinois and Minnesota. The specimens from Delaware (no. 206 *A. Commons*) have aristate glumes

equalling or slightly exceeding the florets and awns of the latter 6–10 mm. long. An exact counterpart of this form, but awnless and placed under the species, was collected by C. R. Ball at Athens, Illinois, in 1892. The specimens from Pennsylvania (coll. by T. C. Porter, 1895), with rather loose subpyramidal panicles are exactly represented by awnless specimens collected in Illinois by J. Wolf in 1892. The latter are referred to the species.

5. Muhlenbergia foliosa Trin. Gram. Unifl. 190. 1824. *Trichochloa foliosa* Trin. Fund. Agros. 117. 1820. *Agrostis foliosa* R. & S. Syst. **2**: 373. 1817. *Agrostis filiformis* Willd. Enum. Hort. Berol. **1**: 95. 1809, not Sprengel 1807. *Agrostis filiformis* Muhl.! Gram. 66. 1817. *A. lateriflora filiformis* Torr. Fl. **1**: 66. 1824. *Muhlenbergia mexicana filiformis* Scribn. Mem. Torr. Bot. Club. **5**: 36. 1894. *Muhlenbergia mexicana* of authors in part. Culms branched above rarely to the base, branches elongated; panicles 5–15 cm. long, narrowly lanceolate to filiform, long-exserted, densely flowered, more or less interrupted especially towards the base.

The type of Muhlenberg's *Agrostis filiformis* is in his herbarium, deposited in the Academy of Natural Sciences of Philadelphia, and is the species here referred to *Muhlenbergia foliosa* Trin. assuming that it is identical with the *Agrostis filiformis* of Willdenow upon which *M. foliosa* was founded. Both Willdenow and Muhlenberg note the close affinity of this species with *M. mexicana* and Trinius in his later writings (Trans. St. Petersb. Acad. VI, **6**[2]: 278. 1841) refers *M. foliosa* to that species. The habit of the plant and especially the fewer much exserted and more elongated panicles and more densely flowered panicle-branches serve to distinguish the species as here classified. *Agrostis frondosa* Poir. Encycl. Suppl. **1**: 252. 1810, was considered by Roemer & Schultes as identical with *Agrostis filiformis* Willd. The identity of Poiret's species is now doubtful; he says of it that it grows in Germany and resembles *Agrostis mexicana* Linn. in its inflorescence.

Among the specimens in the National Herbarium referred to *Muhlenbergia foliosa* are the following: nos. 524, 526 and 529 *M. L. Fernald,* from Maine, no. 68 *H. B. Dorner* from Indiana; no. 794 *E. A. Mearns* from Minnesota; nos. 1686, 1756, 1764, 1704, and 2848 *P. A. Rydberg* from Nebraska; no. 521 *David Griffiths* from

Wyoming; no. 359 *O. B. Metcalfe* from New Mexico; nos. 26,248, 26,247 and 26,246 *J. Macoun* from Ontario.

5a. Muhlenbergia foliosa **ambigua** Scribn. n. comb. *Muhlenbergia ambigua* Torr. in Nicollet's Rept. 164(237). 1843. *M. sylvatica* Auct. in part. Lemmas awned; awns 4–10 mm. long. Otherwise as in the species.

A specimen of the type collection of *Muhlenbergia ambigua* is in the National Herbarium. Other specimens referred here are no. 26,244 *J. Macoun*; no. 80 *Wm. Harriot*; no. 525 *M. L. Fernald*, 1893; no. 527 *M. L. Fernald*, 1894. A specimen from Delaware, collected by A. Commons in 1897, has panicles rather more closely flowered and more rigid than usual. An awnless counterpart of this form was collected by C. R. Ball in Ohio in 1892. The presence of a more or less developed second floret noted in the original diagnosis of *M. ambigua*, occurs in other species of this group.

5b. Muhlenbergia foliosa **setiglumis** Scribn. n. comb. *M. sylvatica setiglumis* S. Wats. U. S. Geol. Expl. Exped. 40th Par. **5**: 378. 1871. "Glumes attenuate into a scabrous bristle 2½–3 lin. long; the palet with its awn about twice longer" (S. Wats. l. c.). The habit of this subspecies is entirely that of *Muhlenbergia foliosa* and the plant differs from *M. foliosa ambigua* only in the awn-like prolongation of the glumes beyond the floret as in *M. racemosa*. A specimen from the type collection is in the National Herbarium, no. 1,288 *S. Watson*, from near Warm Springs, Humboldt Pass, Nevada. To this subspecies are referred no. 2,838 *T. A. Williams* from Wyoming; no. 3 *Williams* from South Dakota; no. 927 *Griffiths & Morris* from Oregon and no. 2 *F. P. Briggs* from Bradley, Maine, In Briggs' specimen the glumes equal or much exceed the florets in different spikelets in the same panicle.

6. **Muhlenbergia umbrosa** Scribn. n. nom. *Agrostis sylvatica* Torr. Fl. U. S. **1**: 87. 1824, not Linn. 1762. *Agrostis diffusa* Muhl. Gram. 64. 1817, not Host 1809. *Muhlenbergia sylvatica gracilis* Scribn. Trans. Kans. Acad. Sci. **9**: 116. 1885, not *M. gracilis* Kunth 1829.

Muhlenbergia sylvatica Torr. & Gray was based upon *Agrostis sylvatica* Torrey, who changed the name from *Agrostis diffusa* Muhl. because of an earlier *Agrostis diffusa* by Host, apparently overlooking the much earlier *Agrostis sylvatica* of Linnaeus. There being no

other name available for this very well defined species a new one, *M. umbrosa*, is here proposed.

Torrey thus describes the species closely following Muhlenberg in his diagnosis of *Agrostis diffusa* "Culms erect, much branched, diffuse, smooth; stipules lacerate panicle filiform; corolla longer than the calyx; awns three times as long as the flower." Torrey compares the species with *M. tenuiflora* from which he says it differs "in being much branched and diffuse, the glumes are also longer and narrower and the culms are glabrous at the nodes."

The type of this species is in Muhlenberg's herbarium in the Academy of Natural Sciences of Philadelphia. It has much branched culms with numerous filiform panicles and long-awned spikelets. No. 205 *A. Commons* from Delaware and no. 461 *B. Fink* from Iowa, both in the Natl. Herbarium are identical with the type. The general aspect of the species is unlike that of either *M. foliosa ambigua* or *M. mexicana commutata,* both of which have heretofore been referred to *M. sylvatica* by authors. The panicles are more slender, the spikelets are less crowded and are usually pale green or straw-colored, never violet or purplish as is usual in those subspecies.

6a. Muhlenbergia umbrosa **attenuata** Scribn. n. subsp. Lemmas awnless or merely mucronate-pointed. Otherwise as in the species. Type, no. 25 *E. N. Wilcox* from Aurora Co., South Dakota. No. 27 *J. H. Kellogg* from Missouri; no. 8096 *E. S. Steele* from the District of Columbia; no. 523 *M. L. Fernald* from Maine, belong here. The subspecies ranges from Maine to Dakota and Nebraska southward to Missouri and Kansas.

A very careful study of the abundant material classified under *Muhlenbergia mexicana* and *M. sylvatica* in the National Herbarium, has led to the interesting conclusion that both these species present awned and awnless forms and that the true *M. sylvatica* should be limited to the *Agrostis diffusa* of Muhlenberg, a well marked species quite distinct from awned forms of *M. mexicana* or of the restored *M. foliosa* of Trinius. In the case of these latter species it was found that every slight variation in habit in plants with awnless spikelets could be exactly matched by awned specimens, the presence of the awn being the only difference whatever. The natural conclusion is that the awnless and awned plants belong to the same species and that at best the latter (those with awned spikelets) could only be treated as subspecies of the former. It appears also, that *Muhlen-*

bergia Schreberi, M. tenuiflora and *M. umbrosa,* all awned species, present forms in which the awns are very much reduced and that in the awnless *M. sobolifera* an awned form occurs. The importance of the awn as a character for diagnosis in this group of species has apparently been much overestimated.

7. Muhlenbergia racemosa (Michx.) B. S. P. Prelim. Cat. Pl. N. Y. 67. 1888. *Agrostis racemosa* Michx. Fl. **1**: 53. 1803. *Agrostis setosa* Muhl. Gram. 68. 1817. *Trichochloa glomerata* Trin. Fund. Agros. 117. 1820. *Muhlenbergia glomerata* Trin. Gram. Unifl. 191. 1824. This well known species ranges from Newfoundland to Washington and British Columbia and southward in the east to North Carolina and in the west to Texas (?), New Mexico and Arizona.

7a. Muhlenbergia racemosa ramosa (Vasey) Beal. Grasses N. Am. **2**: 253. 1896. *M. glomerata ramosa* Vasey Cat. Grasses U. S. 40. 1885. "A much branched spreading form, Illinois to Colorado and Montana" (Vasey l. c.). "Stout, much branched below, very leafy. Prairie regions." (Vasey Contrib. U. S. Natl. Herb. **3**: 68. 1892.) No. 397 *Griffiths* from South Dakota, no. 405 *B. F. Bush* from Missouri, no. 2853 *F. Clements* from Nebraska and no. 265 *B. B. Smyth* from Kansas belong here. This is the common form in the prairie regions of the west.

7b. Muhlenbergia racemosa **violacea** Scribn. n. subsp. characterized by its slender simple culms usually violet or dark purple and more or less interrupted panicles, abruptly aristate glumes and comparatively small spikelets. Type from North Hannibal, New York, collected by *O. E. Pearce* 1883 without number. No. 748 *E. H. Mearns* from Minnesota belongs here. This subspecies is less well defined than the last. It is apparently common in the north growing usually in bogs.

8. **Muhlenbergia glabrifloris** Scribn. n. sp. A slender branching glabrous perennial 4–6 dm. high, from scaly rootstocks, with flat erect or ascending leaves, slender strict panicles and awnless spikelets 2.5–3 mm. long. Culms terete, very minutely scabrous for a short distance below the nodes, soboliferous at the base; sheaths somewhat compressed, smooth, mostly shorter than the internodes, crowded on the branches, naked at the throat; ligule very short, 1 mm. or less long, minutely ciliate on the edge; leaf-blades 2–10 cm. long, 1–4 mm. wide, acute, very minutely scabrous

along the margins and nerves; panicles simple, 2–6 cm. long, occasionally somewhat glomerate, the closely flowered short branches appressed, usually partly enclosed in the subtending leaf-sheath; pedicels scabrous, usually much shorter than the spikelets; spikelets ovate-lanceolate; glumes lanceolate, acute or acuminate-pointed, subequal, a little shorter than, as long as, or a little longer than the floret, scabrous on the keel excepting near the base; lemmas ovate or oblong, obtuse or submucronate-pointed, scabrous on the keel and lateral nerves above, otherwise smooth, no hairs at the base; palea ovate-oblong, obtuse, equalling or a little shorter than the lemmas.

Type, no. 5 *J. Reverchon*, from Texas in the National Herbarium. Other specimens are from Illinois, *J. Wolf* and *E. Hall.* Hall's specimen is presumably from Athens in 1868 and was first referred to *M. sylvatica* by Vasey, who later regarded it as a doubtful variety of *M. mexicana.* The culms are branching throughout and the numerous small panicles terminating the branches and partly included in the subtending leaf-sheaths present the habit of *M. mexicana*, but the plant is more slender throughout especially in its panicles, the texture of the glumes and lemmas is much softer and the latter are perfectly smooth at the base there being no hairs either upon the callus or on the body of the lemma. The spikelets are rather those of a *Sporobolus* than a *Muhlenbergia* but the plant evidently belongs with the soboliferous species of the latter.

Bureau of Plant Industry,
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Washington, D. C.

THE ALPINE RHINANTHUS OF QUEBEC AND NEW HAMPSHIRE.

M. L. Fernald.

The plants which have long passed in eastern America as *Rhinanthus Crista-galli* L., in part (*R. minor* Ehrh.), occupy two strikingly different geographic areas. One, apparently the true *R. Crista-galli* (*R. minor*), abounds in sterile fields and meadows, and along road-

sides and borders of thickets in eastern Quebec and Newfoundland, chiefly near the coast, and extends thence southward along the New England coast. The other has long been known in alpine regions of the White Mountains, and in 1881 it was collected by Mr. John A. Allen upon Table-topped Mountain in Gaspé Co., Quebec.

The writer has long felt that the plant of Oakes Gulf and the Alpine Garden in the White Mountains and of Table-topped Mountain in Gaspé should not be regarded as identical with the coastal *Rhinanthus Crista-galli*, but not until the past summer has he had an opportunity to test his convictions by study in the field of the alpine plant. In August last, however, this Rhinanthus was found in profusion on cool boggy meadows and open slopes at altitudes varying from 950 to 1125 meters, on Table-topped Mountain. It was most abundant in meadows, where it was associated with *Phleum alpinum, Deschampsia atropurpuresa, Juncu castaneus, Salix vestita, S. argyrocarpa, Rubus arcticus, Pyrola grandiflora, Veronica alpina*, var. *unalaschcensis, Castilleja pallida*, var. *septentrionalis, Gnaphalium norvegicum*, and other arctic-alpine species, with some of which it occurs in the White Mountains. Abundant flowering and fruiting material was secured, and notes were made from the fresh plant, which, upon the return to the shores of the lower St. Lawrence, showed that the alpine Rhinanthus is clearly distinct from the common coastal *R. Crista-galli*. A detailed study of this and of the other species of *Rhinanthus* of America and of northern Europe, as recently defined in the works of Chabert, Sterneck, and others, shows, furthermore, that the plant of the White Mountains and of Table-topped Mountain is apparently an undescribed species, and that it occurs also on the coast of Labrador. This plant, from the characteristic outline of the cauline leaves may be called

Rhinanthus **oblongifolius**, n. sp. Planta 0.6–4 dm. alta viridis basi glabra superne ad internodiorum latera pilosa simplex; foliis caulinis quam internodia brevioribus oblongis vel in speciminibus minoribus linearibus scabridis obtusis crenato-dentatis, dentibus latis appressis; spicis 2–12-floris; bracteis scabris, infimis foliis supremis similibus, mediis et superioribus triangulari-ovatis attenuatis calycem subaequantibus laciniato-dentatis, dentibus inferioribus patulis aristato-acuminatis quam superiores longioribus; calyce florifero ovato-oblongo fructifero suborbiculato 1.3–1.9 cm. longo glabrescente, marginibus ciliatis; corolla flava 1–1.2 cm. longa, tuba recta exserta; labia superiore 3–4 mm. longa, margine inferiore convexo dentibus flavis oblique quadrilateralibus subtruncatis 0.5 mm. longis, 1.5 mm. latis;

abia inferiore 1 mm. longa flava vel raro violacea; seminibus reniformibus 5–6 mm. longis 3.5 mm. latis olivaceis, alis dorsalibus membranaceis, ventralibus obscuris.

Plant 0.6–4 dm. high, green, glabrous at base, pilose along the sides of the internodes above, simple: cauline leaves shorter than the internodes, oblong, or in very small specimens linear, scabrid, obtuse, crenate-dentate; the teeth broad and appressed: spikes 2–12-flowered: bracts scabrous, the lower similar to the upper leaves, the middle and upper triangular-ovate, attenuate, about equalling the calyx, laciniate-dentate; the lower teeth spreading, aristate-acuminate, longer than the upper: flowering calyx ovate-oblong; fruiting suborbicular, 1.3–1.9 cm. long, glabrescent, the margins ciliate: corolla yellow, 1–1.2 cm. long, the straight tube exserted; the upper lip 3–4 mm. long, its lower margin convex, the teeth yellow, obliquely quadrilateral, subtruncate, 0.5 mm. long, 1.5 mm. broad; the lower lip 1 mm. long, yellow or rarely violaceous: seeds reniform, 5–6 mm. long 3.5 mm. wide, olive-brown, the dorsal wing membranaceous, the ventral obscure.— QUEBEC, common on alpine meadows and slopes, altitude 950–1125 m., Table-topped Mountain, Gaspé Co., August 7, 1906 (*Fernald & Collins*, no. 248), August 12, 1881 (*J. A. Allen*): NEW HAMPSHIRE, "in alpinis Montium Alborum" (*Wm. Oakes*); "White Mount. in locis humidis alpinis cum *Veronica alpina* et caet," 1843 (*E. Tuckerman*); head of Oakes Gulf, August 28, 1877, August 29, 1890 (*E. & C. E. Faxon*); moist grassy soil, edge of Oaks Gulf, August 8, 1896 (*E. F. Williams*); Lion's Head, Alpine Garden, Mt. Washington, September 1, 1890 (*E. & C. E. Faxon*). Various specimens from the Labrador coast are apparently referable here.

From the essentially coastal *Rhinanthus Crista-galli* of New England and the Maritime Provinces *R. oblongifolius* is distinguished by several characters. In the coastal plant the leaves are narrower, lance- or linear-attenuate, and sharply serrate with more spreading teeth; and in drying the stems and foliage become strongly blackened. *R. oblongifolius*, with oblong crenate-toothed leaves, on the other hand, retains its green color even in the old specimens of Oakes. In *R. Crista-galli* the lateral teeth of the upper lip of the corolla are about as long as broad and dark-colored; in *R. oblongifolius* much broader than long and yellow. In *R. Crista-galli* the ventral wing of the seed is conspicuously thickened and clearly defined; in the seed of *R. oblongifolius* it is only slightly thickened and less clearly defined.

GRAY HERBARIUM.

Is Rhinanthus Crista-galli an introduced Plant? — As long as all our New England *Rhinanthus* was supposed to be *R. Crista-galli* L. there was no question as to its being indigenous; its center of distribution was thought to be among the alpine or subalpine plants of the White Mountains, and its occurrence elsewhere seemed to indicate a distribution by no means unprecedented, since some plants found at a considerable elevation in Vermont and New Hampshire occur along the coast of Maine, a range recalling the distribution of the hermit thrush and some other distinctive White Mountain birds, which breed at sea level as far to the southwest as Casco Bay. But now that the White Mountain *Rhinanthus* is found to be a distinct and new species, the character of the stations in which the true *R. Crista-galli* occurs is worthy of notice. It seems to be always in fields and pastures and along roadsides; never away from human influence.

The writer first saw the plant at Cushing, Maine; the attention of a farmer being called to it, as a novelty to the writer, he replied: "Yes, it is getting to be very common now-a-days." At Cape Rosier, and at Eagle Island in Penobscot Bay, it was very common, but at both places the older farmers said that it was not there in their younger days; at Cape Rosier they called it "Mormon Weed," as it made its appearance at the time of the Mormon excitement, that is, some time after 1850. It was reported to have been introduced into Eagle Island in hay from the mainland. While the question of its being a native or a naturalized foreigner can hardly be settled positively, it would seem that the probabilities are in favor of the latter theory.— F. S. Collins, Malden, Massachusetts.

Acanthospermum australe at Lawrence, Massachusetts.— A plant which grew last summer in a cabbage-garden in the suburbs of Lawrence attracted attention as something unusual and an unsuccessful effort was made to classify it. A specimen was sent to the Gray Herbarium and there determined as *Acanthospermum australe* (Loefl.) Ktze., a peculiar member of the *Compositae*, which is ordinarily confined to tropical regions. The cabbage field where the Acanthospermum grew had been fertilized by wool-waste from one of the mills, and as several strange plants were seen there the locality will be watched with interest another season. — E. S. Schneider, Lawrence, Massachusetts.

FURTHER INFORMATION REGARDING THE OCCURRENCE OF DRYOPTERIS FILIX-MAS IN VERMONT.

MABEL A. STRONG.

ON the twelfth of last August, while spending a day in the woods in central Vermont I had the pleasure of finding *Dryopteris Filix-mas*. At first I saw only five or six clumps, containing from one to six plants each and growing in a partially exposed place, seemingly an old wood road or spring water course and overgrown with thin grass, dwarfed raspberry bushes and weeds; but upon a second visit and more careful exploration I counted over forty clumps comprising a hundred or more plants and extending farther into the deeper woods. The whole group, so far as observed, covered an area which one might have walked around in perhaps three minutes. The individual ferns varied from tiny ones to magnificent specimens waist high.

Noticeable at the edge of the deeper wood and shading some of the ferns in question are several large butternut trees. The soil is very black and rich while the underlying and partially exposed ledges are of a lead-colored rock. At the left side of this road or water course is a thick growth of sapling maples, but none of the ferns were found there.

This wood crowns the top of a pasture hill at an elevation of about sixteen hundred feet and has a northern exposure. It is situated in the southwestern corner of the town of Woodstock near the Bridgewater and Reading lines. In other words it is about six miles due west of Hartland Four Corners, where Miss Darling discovered this fern over a year ago.

Growing in the midst of the area just described is one fine clump of *Dryopteris Goldiana* and distributed through the woods are quantities of the finest specimens of Braun's Holly Fern I have ever seen, excepting those growing near the summit of Killington.

Several other species of *Dryopteris* are found in the immediate vicinity, namely *D. spinulosa, D. marginalis, D. noveboracensis,* and *D. acrostichoides,* while somewhat lower on the slope and in the open pasture occur *Dicksonia, Adiantum,* and *Asplenium Filix-foemina.*

A few rods farther down the road leading past this place and toward Long Hill in Bridgewater, Miss Elizabeth Billings found the Blue Fringed Gentian growing.

Woodstock, Vermont.

Arceuthobium in the Rangeley Region.— While walking along the line of the South Bog Railroad, in the township of Rangeley Plantation, Maine, I passed through a considerable quantity of Black Spruce. A few of the trees had suspicious-looking "witches' brooms" on them, which proved on investigation to contain *Arceuthobium pusillum* Peck. Very few of the trees, however, were thus affected. The nearest recorded station for this species so far as I know is in Pleasant Ridge Township, about forty miles to the east of the one reported here.— John Murdoch, Jr., Harvard Forestry Expedition.

Note on Cirsium muticum, var. monticola.— In the Ottawa Naturalist, I recently described the alpine thistle of the Shickshock Mountains, and inadvertently placed it in *Cnicus*, a genus which, as now everywhere interpreted, consists of the single species, *Cnicus benedictus*, the Blessed Thistle. The plant of the Shickshock Mountains should bear the name

Cirsium muticum Michx., var. **monticola**, n. comb.—*Cnicus muticus*, var. *monticola* Fernald, Ottawa Nat. xix. 166 (1905).— Explorations during the past summer showed that on Mt. Albert this plant abounds throughout the serpentine area, descending from the alpine meadows, in the gorge of Ruisseau à la Neige, nearly to Lac au Diable at an altitude of 550 meters; while it is apparently quite absent from the hornblende district of the mountain. It was also found on Table-topped Mountain, in a single alpine meadow whose mixed soil supported *Danthonia intermedia*, *Solidago multiradiata*, and a few other plants, which in the Shickshock Mountains have their great development on the serpentine.— M. L. Fernald, Gray Herbarium.

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ON THE RULES OF BOTANICAL NOMENCLATURE ADOPTED BY THE VIENNA CONGRESS.

Introductory.

No subject connected with systematic botany has in recent years been more earnestly discussed than the nomenclature question. Indeed, the prolonged and detailed controversies regarding this matter must have been wearisome to many persons who, although interested in plants, have had no leisure or desire to go into bibliographical technicalities. To such persons, however, as well as to the professional taxonomist, it should be a source of gratification that a considerable step has been taken toward international agreement on the points at issue.

Before the rules and recommendations adopted by the Vienna Botanical Congress are here presented, it may be well to advert very briefly to the peculiar difficulties which have been involved in the nomenclature question and to recall the circumstances of the international meeting at Vienna.

For many decades it has been almost universally felt that botanical nomenclature should rest in a general way on the principle of priority of publication, or in other words, that the name of a plant was the first one assigned to it. Nearly all botanists of note have readily assented to this general idea, but great difficulties have arisen regarding the precise limitations which should be imposed upon the principle. Thus, botanists of past generations, including such great leaders as the De Candolles, Bentham, the Hookers, Gray, von Martius, Eichler, Baillon, and others, have followed the principle of priority, yet they have made frequent exceptions based on considerations of taste and convenience as well as practicality.

With the expansion of the subject the difficulty of agreement on these exceptions has increased and some recent writers have been disposed at times to criticise rather harshly the earlier botanists for making any exceptions whatever. It should be noticed, however, that even the more strenuous of these reformers themselves admit certain exceptions. They have found it necessary, for instance, to fix initial dates, and to rule out certain names as too vague in their definition or too uncouth in their form to be accepted.

Ideas as to the best mode of establishing rules or reaching a general agreement regarding the necessary exceptions to the bald principle of priority have differed widely and given rise to lively controversy. To some it has seemed best to devise an ideal system and then, without much reference to the wishes or convenience of their colleagues, to apply it in local publication. The idea of such writers has been, if we understand it rightly, that a system of rules if devised with sufficient care would ultimately gain adherence and be recognized as worthy of general adoption.

To the vast majority, however, it has been clear that the subject was a broad one involving much mutual sacrifice before the now divergent usages at different botanical centres could be brought into harmony. It was also decidedly an international question. If our Latin botanical nomenclature has any real significance it is that botanists of remote regions and different nations may have a common technical language. It was therefore evident that rules devised in one country stood exceedingly little chance of adoption in others and that the whole question could be settled only by a patient effort at international understanding.

In this way uniformity can be attained gradually. In the first place it should be possible to reach agreement on some of the more obvious rules, upon such in fact as are sufficiently evident in the present state of botanical classification to make not only their need of settlement but the particular way in which they should be decided, clear to the majority of systematists of different nations. If such general principles can be decided and the majority of botanists convinced of their fairness, much will have been accomplished. Attention can then be turned to minor details on which opinions are still widely divergent, and, as each successive matter reaches such clearness as to make its solution possible by international agreement, it can then be taken up and decided by subsequent international gatherings.

The great advantage of such a method of gradually getting all nations into harmony will be evident to every thoughtful and broad-minded person interested in botany. In fact it appears to be, if not the speediest method imaginable, at least the most practicable — the way, in fact, which will bring us to the desired uniformity with the least friction, with the least feeling of injustice, and the minimum production of needless synonyms.

For the last fifteen years there has been a growing desire for an international meeting of representative botanists who should give the matter of nomenclature careful consideration and come if possible to some agreement on the fundamental rules to be followed. This feeling took definite form in the year 1900 when preliminary sessions of such a gathering were held in connection with the Paris Congress of botanists. At this meeting a bureau was formed for the organization of an International Botanical Congress to be held at Vienna in June, 1905.

A commission of forty-seven botanists, representing all the more important countries of the world was also formed, to whom advisory power in the arrangements for the Vienna Congress was intrusted. This commission was well selected to include persons not merely of high standing in systematic botany but representing the most diverse views on nomenclature. The commission worked in harmony and special credit is due to Prof. John Briquet of Geneva, the reporter-general, who devoted for some years much of his time to the arrangements for the congress.

It was early decided that the proper basis for any new group of rules would be the time-honored Paris Code of 1867, often called the De Candollean Code. Botanists of the world were invited to submit their propositions for the amendment and improvement of this code and ample time given them for the purpose. Many responded with carefully elaborated propositions and suggestions. Months before the congress was called together the reporter-general published a detailed statement, not only of all the new suggestions, which had been received, but of all the important propositions published on the subject of botanical nomenclature since 1867, the date of the old code. These matters were lucidly presented in a large quarto publication printed in parallel columns and giving an admirable means of comparing the different systems proposed.

Representation at the Vienna Congress was freely offered to all

the leading botanical establishments of the world, to botanical and natural history societies and academies, and finally to all those botannists who had offered amendments to the older code. Circular after circular was issued and it would be difficult to conceive of any expedient which was not employed to make the congress representative and render its proceedings intelligent and thoroughly impartial.

To the great credit of our science, it may be said without reservation, that the leading botanical establishments of the world took the congress seriously. There met at Vienna between five and six hundred botanists. A week was spent in the various sessions of the congress. During this time the systematists met daily in prolonged and very earnest sessions for discussion and legislation on the nomenclature matter. They were permitted to speak in French, English, or German, and the substance of their remarks was promptly translated into each of the other two of these languages. The meeting was exceptionally fortunate in its chairman, Prof. Charles Flahault of Montpellier, whose quick understanding of complicated situations, skilful generalship of the polyglot debates, and obvious impartiality commanded universal respect and gained general commendation. Every opportunity for free discussion was given so far as time permitted.

Several readers of Rhodora have expressed the wish that the rules adopted by the Vienna Congress should be printed in our journal and the English version is herewith given. The list of generic names, which, notwithstanding technical lack of priority, it was decided to retain, includes about four hundred names. Lack of space does not permit the reprinting of this list in full but the names are here given which apply to our New England flora.

It will be a matter of great interest to the readers of Rhodora to learn that many of the leading botanical establishments of the world have already signified either officially or unofficially their intention to accept the Vienna rulings, indeed this acceptance has been so general as to render divergent practice hereafter merely local and provincial.

A question, which has been very frequently asked, is how much change these rules will entail in current usage. It is very difficult to give any precise answer, but, in a general way, it may be said, so far as the Grayan nomenclature common in New England is concerned, the adoption of the Vienna rules is likely to necessitate change

of 3 to 5 per cent. of generic names and between 10 and 20 per cent. of specific names. Persons judging of this matter are specially urged to make careful distinction between changes caused by the new rules on the one hand and the host of alterations on the other which are rendered necessary by new light upon plant affinities, the limitation of species, division of confused genera, etc.— alterations which are botanical rather than nomenclatorial in their nature.

International rules for Botanical Nomenclature chiefly of Vascular Plants.

Chapter I. **General considerations and leading principles.**

Art. 1. Natural history can make no progress without a regular system of nomenclature, which is recognized and used by the great majority of naturalists in all countries.

Art. 2. The prescriptions which govern the exact system of botanical nomenclature are divided into *principles, rules* and *recommendations.* The principles (art. 1–9, 10–14 and 15–18) are the foundation of the rules and recommendations. The rules (art. 10–58), destined to put in order the nomenclature which the past has bequeathed to us, and to form the basis for the future, are always retroactive: names or forms of nomenclature which are contrary to a rule cannot be maintained. Recommendations bear on secondary points, their object being to ensure for the future a greater uniformity and clearness in nomenclature: names or forms of nomenclature contrary to a recommendation are not a model to copy, but cannot be rejected.

Art. 3. The rules of nomenclature should neither be arbitrary nor imposed by authority. They must be simple and founded on considerations clear and forcible enough for everyone to comprehend and be disposed to accept.

Art. 4. The essential points in nomenclature are: 1. to aim at fixity of names; 2. to avoid or to reject the use of forms and names which may cause error or ambiguity or throw science into confusion.

Next in importance is the avoidance of all useless creation of names.

Other considerations, such as absolute grammatical correctness, regularity or euphony of names, more or less prevailing custom,

respect for persons, etc., notwithstanding their undeniable importance are relatively accessory.

Art. 5. No custom contrary to rule can be upheld if it leads to confusion or error. When a custom offers no serious inconvenience of this kind, it may be a ground for exceptions which we must however abstain from extending or copying. Finally in the absence of rule, or where the consequences of rules are doubtful, established custom becomes law.

Art. 6. The principles and forms of nomenclature should be as similar as possible in botany and in zoology; but botanical nomenclature is entirely independent of zoological nomenclature.

Art. 7. Scientific names are in latin for all groups. When taken from another language, a latin termination is given them, except in cases sanctioned by custom. If translated into a modern language, it is desirable that they should preserve as great a resemblance as possible to the original latin names.

Art. 8. Nomenclature comprises two categories of names: 1. Names, or rather terms, which express the nature of the groups comprehended one within the other. 2. Names peculiar to each of the groups of plants that observation has made known.

Art. 9. The rules and recommendations of botanical nomenclature apply to all classes of the plant kingdom, reserving special arrangements for fossil plants and non-vascular plants.[1]

Chapter II. **On the manner of designating the nature and the subordination of the groups which constitute the plant kingdom.**

Art. 10. Every individual plant belongs to a species (*species*), every species to a genus (*genus*), every genus to a family (*familia*) every family to an order (*ordo*), every order to a class (*classis*), every class to a division (*divisio*).

Art. 11. In many species we distinguish varieties (*varietas*) and forms (*forma*); and in some cultivated species, modifications still more numerous; in many genera sections (*sectio*), in many families tribes (*tribus*).

Art. 12. Finally if circumstances require us to distinguish a greater number of intermediate groups, it is easy, by putting the

[1] These special arrangements have been reserved for the Congress of 1910. They comprise: 1. rules bearing on special points in relation to the nature of fossils or the lower plants; 2. lists of *nomina conservanda* for all divisions of plants other than Phanerogams.

syllable *sub* before the name of a group, to form subdivisions of that group. In this way subfamily (*subfamilia*) designates a group between a family and a tribe, subtribe (*subtribus*) a group between a tribe and a genus, etc. The arrangement of subordinate groups may thus be carried, for wild plants only, to twenty-one degrees, in the following order: Regnum vegetabile. Divisio. Subdivisio. Classis. Subclassis. Ordo. Subordo. Familia. Subfamilia. Tribus. Subtribus. Genus. Subgenus. Sectio. Subsectio. Species. Subspecies. Varietas. Subvarietas. Forma. Individuum. If this list of groups is insufficient it can be augmented by the intercalation of supplementary groups, so long as these do not introduce confusion or error.

Example: *Series* and *Subseries* are groups which can be intercalated between subsection and species.

Art. 13. The definition of each of these names of groups varies, up to a certain point, according to individual opinion and the state of the science, but their relative order, sanctioned by custom must not be altered. No classification is admissible which contains such alterations.

Examples of inadmissible alterations are,— a form divided into varieties, a species containing genera, a genus containing families or tribes.

Art. 14. The fertilization of one species by another, gives rise to a hybrid (*hybrida*); that of a modification or subdivision of a species by another modification of the same species gives rise to a half-breed (*mistus*, *mule* of florists).

Recommendations.

I. The arrangement of species in a genus or in a subdivision of a genus is made by means of typographic signs, letters or numerals. Hybrids are arranged after one of the parent species, with the sign × placed before the generic name.

The arrangement of subspecies under a species is made by letters or numerals; that of varieties by the series of greek letters α, β, γ, etc. Groups below varieties and also half-breeds are indicated by letters, numerals or typographic signs at the author's will.

Modifications of cultivated plants should be associated, as far as possible, with the species from which they are derived.

Chapter III. On the manner of designating each group or association of plants.

Section 1. General principles; priority.

Art. 15. Each natural group of plants[1] can bear in science only

[1] See observation to article 9.

one valid designation, namely the oldest, provided that it is in conformity with the rules of Nomenclature and the conditions laid down in articles 19 and 20 of section 2.

Art. 16. The designation of a group by one or several names is not for the purpose of describing the characters or the history of the group, but that we may be understood when we wish to speak of it.

Art. 17. No one should change a name or a combination of names without serious motives, based on a more profound knowledge of facts, or on the necessity of giving up a nomenclature that is contrary to rules.

Art. 18. The form, number and arrangement of names depend on the nature of each group, according to the following rules.

Section 2. **Point of departure for nomenclature; limitation of principle of priority.**

Art. 19. Botanical nomenclature begins with the *Species Plantarum* of Linnaeus, ed. 1. (1753) for all groups of vascular plants. It is agreed to associate genera, the names of which appear in this work, with the descriptions given of them in the *Genera Plantarum* ed. 5. (1754).

Art. 20. However, to avoid disadvantageous changes in the nomenclature of genera by the strict application of the rules of Nomenclature, and especially of the principle of priority in starting from 1753, the rules provide a list of names which must be retained in all cases. These names are by preference those which have come into general use in the fifty years following their publication, or which have been used in monographs and important floristic (floristiques) works up to the year 1890. The list of these names forms an appendix to the rules of Nomenclature.

Section 3. **Nomenclature of the different kinds of groups.**

§ 1. *Names of groups above the family.*

Recommendations. The following suggestions as to the nomenclature of groups of higher rank than the family will tend to clearness and uniformity.

II. Names of divisions and subdivisions, of classes and subclasses are taken from one of their characters. They are expressed by words of greek or latin origin, some similarity of form and termination being given to those that designate groups of the same nature.

Examples: *Angiospermae, Gymnospermae; Monocotyledoneae, Dicotyledoneae; Pteridophyta; Coniferae.* Among Cryptogams old family names such as *Fungi, Lichenes, Algae,* may be used for names of groups above the rank of family.

III. Orders are designated preferably by the name of one of their principal families, with the ending *-ales*. Suborders are designated in a similar manner, with the ending *-ineae*. But other terminations may be retained for these names, provided that they do not lead to confusion or error.

Examples of names of orders: *Polygonales* (from *Polygonaceae*), *Urticales* (from *Urticaceae*), *Glumiflorae, Centrospermae, Parietales, Tubiflorae, Microspermae, Contortae.* Examples of names of suborders: *Bromeliineae* (from *Bromeliaceae*), *Malvineae* (from *Malvaceae*), *Tricoccae, Enantioblastae.*

§ 2. *Names of families and subfamilies, tribes and subtribes.*

Art. 21. Families (*familiae*) are designated by the name of one of their genera or ancient generic names with the ending *-aceae.*

Examples: *Rosaceae* (from *Rosa*), *Salicaceae* (from *Salix*), *Caryophyllaceae* (from *Dianthus Caryophyllus*), etc.

Art. 22. The following names, owing to long usage, are an exception to the rule: *Palmae, Gramineae, Cruciferae, Leguminosae, Guttiferae, Umbelliferae, Labiatae, Compositae.*

Art. 23. Names of subfamilies (*subfamiliae*) are taken from the name of one of the genera in the group, with the ending *-oideae*. The same holds for the tribes (*tribus*) with the ending *-eae*, and for the subtribes (*subtribus*) with the ending *-inae.*

Examples of subfamilies: *Asphodeloideae* (from *Asphodelus*), *Rumicoideae* (from *Rumex*); tribes: *Asclepiadeae* (from *Asclepias*), *Phyllantheae* (from *Phyllanthus*); subtribes: *Metastelmatinae* (from *Metastelma*), *Madiinae* (from *Madia*).

§ 3. *Names of genera and divisions of genera.*

Art. 24. Genera receive names, substantives (or adjectives used as substantives) in the singular number and written with a capital letter, which may be compared with our own family names. These names may be taken from any source whatever and may even be composed in an absolutely arbitrary manner.

Examples: *Rosa, Convolvulus, Hedysarum, Bartramia, Liquidambar, Gloriosa, Impatiens, Manihot.*

Art. 25. Subgenera and sections also receive names, usually substantives and resembling the names of genera. Names of subsections and other lower subdivisions of genera are preferably adjectives in the plural number and written with a capital letter, or their place may be taken by an ordinal number or a letter.

Examples. — Substantives: *Fraxinaster, Trifoliastrum, Adenoscilla, Euhermannia, Archieracium, Micromelilotus, Pseudinga, Heterodraba, Gymnocimum, Neoplantago, Stachyotypus.* Adjectives: *Pleiostylae, Fimbriati, Bibracteolata, Pachycladae.*

Recommendations.

IV. When the name of a genus, subgenus or section is taken from the name of a person, it is formed in the following manner:

a) When the name ends in a vowel, the letter *a* is added (for example *Glazioua* after Glaziou; *Bureaua* after Bureau), except when the name already ends in *a*, in which case *ea* is added (e. g. *Collaea* after Colla).

b) When the name ends in a consonant, the letters *ia* are added (thus *Magnusia* after Magnus; *Ramondia* after Ramond), except when the name ends in *er*, in which case *a* is added (e. g. *Kernera* after Kerner).

c) The spelling of the syllables unaffected by these finals is retained, even with the consonants *k* and *w* or with groupings of vowels which were not used in classic latin. Letters which are unknown to botanical latin must be transcribed, diacritic signs are suppressed. The german ä, ö, ü become ae, oe, ue, the French é, è and ê become generally e.

d) Names may be accompanied by a prefix, or a suffix, or modified by anagram or abbreviation. In these cases they count as different words from the original name. E. g. *Durvillea* and *Urvillea*, *Lapeyrousea* and *Peyrousea*, *Englera*, *Englerastrum* and *Englerella*, *Bouchea* and *Ubochea*, *Gerardia* and *Graderia*, *Martia* and *Martiusia*.

V. Botanists who are publishing generic names show judgment and taste by attending to the following recommendations:

a) Not to make names very long or difficult to pronounce.

b) Not to use again a name which has already been used and has lapsed into synonymy (homonym).

c) Not to dedicate genera to persons who are in all respects strangers to botany, or at least to natural science, nor to persons quite unknown.

d) Not to take names from barbarous tongues, unless those names are frequently quoted in books of travel, and have an agreeable form that is readily adapted to the latin tongue and to the tongues of civilized countries.

e) To recall, if possible, by the formation or ending of the name, the affinities or the analogies of the genus.

f) To avoid adjectives used as nouns.

g) Not to give a genus a name whose form is rather that of a subgenus or section (e. g. *Eusideroxylon*, a name given to a genus of Lauraceae, which, however, being valid, cannot be changed).

h) Not to make names by the combination of two languages (*nomina hybrida*).

VI. Botanists constructing names for subgenera or sections, will do well to attend to the preceding recommendations and also to the following:

a) Give, where possible, to the principal division of a genus, a name which, by some modification or addition, calls the genus to mind (for instance, *Eu* placed at the beginning of the name, when it is of greek origin; *-astrum*, *-ella* at the end of the name, when latin, or any other modification consistent with the grammar and usages of the latin language).

b) Avoid calling a subgenus or a section by the name of the genus to which it belongs, with the final *-oides* or *-opsis*; on the contrary reserve this ending for a section which resembles another genus, by adding in that case *-oides* or *-opsis* to the name of that other genus, if it is of greek origin, to form the name of the section.

c) Avoid taking as the name of a subgenus or section a name which is already in use as such in another genus, or which is the name of an admitted genus.

VII. When it is required to express a subgeneric or sectional name together with the name of the genus and the name of the species, the name of the section is put between the others in a parenthesis. E. g. *Astragalus* (*Cycloglottis*) *contortuplicatus*.

§ 4. *Names of species and of subdivisions of species.*

Art. 26. All species, even those that singly constitute a genus, are designated by the name of the genus to which they belong followed by a name (or epithet) termed specific, usually of the nature of an adjective (forming a combination of two names, a binomial, or binary name).

Examples: *Dianthus monspessulanus, Papaver Rhoeas, Fumaria Gussonei, Uromyces Fabae, Geranium Robertianum, Embelia Sarasinorum, Adiantum Capillus-Veneris.* Linnaeus has sometimes introduced symbols in specific names; these must according to art. 26 be transcribed. Ex.: *Scandix Pecten-Veneris* (= *Scandix Pecten* ♀); *Veronica Anagallis-aquatica* (= *Veronica Anagallis* ▽).

Recommendations.

VIII. The specific name should, in general, give some indication of the appearance, the characters, the origin, the history or the properties of the species. If taken from the name of a person, it usually recalls the name of the one who discovered or described it, or was in some way concerned with it.

IX. Names of men and women and also names of countries and localities used as specific names, may be substantives in the genitive (*Clusii, saharae*) or adjectives (*Clusianus, dahuricus*). It will be well, in the future, to avoid the use of the genitive and the adjectival form of the same name to designate two different species of the same genus [for example *Lysimachia Hemsleyana* Maxim. (1891) and *L. Hemsleyi* Franch. (1895)].

X. Specific names begin with a small letter except those which are taken from names of persons (substantives or adjectives) or those which are taken from generic names (substantives or adjectives).

Examples: *Ficus indica, Circaea lutetiana, Brassica Napus, Lythrum Hyssopifolia, Aster novibelgii, Malva Tournefortiana, Phyteuma Halleri.*

XI. When a specific name is taken from the name of a man, it is formed in the following way:

a) When the name ends in a vowel, the letter *i* is added (thus *Glazioui* from Glaziou: *Bureaui* from Bureau), except when the name ends in *a*, when *e* is added (thus *Balansae* from Balansa).

b) When the name ends in a consonant, the letters *ii* are added (thus *Magnusii* from Magnus; *Ramondii* from Ramond), except when the word ends in *er* when *i* is added (ex. *Kerneri*, from Kerner).

c) Syllables which are not modified by these endings retain their original spelling, even in the case of the consonants k and w or groupings of vowels which are not used in classic latin. Letters foreign to the latin of botanists should be transcribed, and diacritic signs suppressed. The german ä, ö, ü, become ae, oe, ue, the french é, è, and ê become, in general, e.

d) When specific names taken from the name of a person have an adjectival form a similar plan is adopted (*Geranium Robertianum, Carex Hallerana, Ranunculus Boreauanus*, etc.)

XII. The same applies to the names of women. These are written in the feminine when they have a substantial form.

Example: *Cypripedium Hookerae, Rosa Beatricis, Scabiosa Olgae, Omphalodes Luciliae.*

XIII. In the formation of specific names composed of two or several roots and taken from latin or greek, the vowel placed between the two roots

becomes a connecting vowel, in latin *i*, in greek *o*; thus we write *menthifolia*, *salviifolia*, not *menthaefolia*, *salviaefolia*. When the second root begins with a vowel and euphony demands, the connecting vowel is eliminated (e. g. *calliantha*, *lepidantha*). The connecting *ae* is legitimate only when etymology demands (e. g. *caricaeformis* from *Carica*, may be retained along with *cariciformis* from *Carex*).

XIV. In forming specific names, botanists will do well to note the following recommendations:

a) Avoid very long names and those which are difficult to pronounce.

b) Avoid names which express a character common to all or nearly all the species of a genus.

c) Avoid names taken from little known or very restricted localities, unless the species be very local.

d) Avoid, in the same genus, names which are very much alike, especially those which differ only in their last letters.

e) Adopt unpublished names found in travellers' notes and herbaria, attributing them to the authors concerned, only when those concerned have approved the publication.

f) Avoid names which have been used before in the genus, or in any closely allied genus, and which have lapsed into synonymy (homonyms).

g) Do not name a species after a person who has neither discovered, nor described, nor figured, nor in any way studied it.

h) Avoid specific names formed of two words.

i) Avoid names which have the same meaning as the generic name.

Art. 27. Two species of the same genus cannot bear the same specific name, but the same specific name may be given in several genera.

Example: *Arabis spathulata* DC. and *Lepidium spathulatum* Phil. are valid as two names of Crucifers; but *Arabis spathulata* Nutt. in Torr. and Gray cannot be maintained, on account of the existence of *Arabis spathulata* DC., a name previously given to another valid species of *Arabis*.

Art. 28. Names of subspecies and varieties are formed like specific names and follow them in order, beginning with those of the highest rank. The same holds for subvarieties, forms, and slight or transient modifications of wild plants which receive a name or numbers or letters to facilitate their arrangement. Use of a binary nomenclature for subdivisions of species is not admissible.

Examples: *Andropogon ternatus* subsp. *macrothrix* (not *Andropogon macrothrix* or *Andropogon ternatus* subsp. *A. macrothrix*); *Herniaria hirsuta* var. *diandra* (not *Herniaria diandra* or *Herniaria hirsuta* var. *H. diandra*); forma *nanus*, forma *maculatum*.

Recommendation.

XV. Recommendations made for specific names apply equally to names of subdivisions of species. These agree with the generic name when they have an adjectival form (*Thymus Serpyllum* var. *angustifolius*, *Ranunculus acris* subsp. *Friesianus*).

Art. 29. Two subspecies of the same species cannot have the same name. A given name can only be used once for a variety of a given

species, even when dealing with varieties which are classed under different subspecies. The same holds for subvarieties and forms.

On the other hand the same name may be employed for subdivisions of different species, and the subdivisions of any one species may bear the same name as other species.

Examples. — The following are admissible: *Rosa Jundzillii* var. *leioclada* and *Rosa glutinosa* var. *leioclada*; *Viola tricolor* var. *hirta*, in spite of the existence already of a different species named *Viola hirta*. The following are incorrect: *Erysimum hieraciifolium* subsp. *strictum* var. *longisiliquum* and *E. hieraciifolium* subsp. *pannonicum* var. *longisiliquum* — a form of nomenclature which allows two varieties bearing the same name in the same species.

Recommendation.

XVI. Botanists are recommended to use as little as possible the privilege granted in the second part of article 29, in order to avoid confusion and mistakes and also to reduce to a minimum the necessary changes of name when the subdivisons of species are raised to specific rank or vice versa.

Art. 30. Forms and half-breeds among cultivated plants should receive fancy names, in common language, as different as possible from the latin names of the species or varieties. When they can be traced back to a species, a subspecies or a botanical variety this is indicated by a succession of names.

Example: *Pelargonium zonale* Mrs. Pollock.

§ 5. *Names of hybrids and half-breeds (mules).*

Art. 31. Hybrids between species of the same genus, or presumably so, are designated by a formula and, whenever it seems useful or necessary, by a name.

The formula consists of the names or specific epithets of the two parents in alphabetical order and connected by the sign ×. When the hybrid is of known experimental origin the formula may be made more precise by the addition of the signs, ♀ ♂.

The name, which is subject to the same rules as names of species, is distinguished from the latter by absence of an ordinal number and by the sign × before the name.

Examples: × *Salix capreola* = *Salix aurita* × *caprea*; *Digitalis lutea* ♀ × *purpurea* ♂; *Digitalis lutea* ♂ × *purpurea* ♀.

Art. 32. Intergeneric hybrids (between species of different genera) or presumably such, are also designated by a formula, and, when it seems useful or necessary, by a name.

The formula consists of the names of the two parents, in alphabetical order.

The hybrid is associated with the one of the two genera which precedes the other in alphabetical order. The name is preceded by the sign ×.

Examples: × *Ammophila baltica* = *Ammophila arenaria* × *Calamagrostis epigeios.*

Art. 33. Ternary hybrids, or those of a higher order, are designated like ordinary hybrids by a formula and a name.

Examples: × *Salix Straehleri* = *S. aurita* × *cinerea* × *repens* or *S.* (*aurita* × *repens*) × *cinerea.*

Art. 34. When there is reason to distinguish the different forms of a hybrid (pleomorphic hybrids, combinations between different forms of collective species etc.) the subdivisions are classed under the hybrid like the subdivisions of species under a species.

Examples: × *Mentha villosa* β *Lamarckii* (= *M. longifolia* × *rotundifolia*). The preponderance of the characters of one or other parent may be indicated in the formulas in the following manner: *Mentha longifolia* > × *rotundifolia*, *M. longifolia* × < *rotundifolia*, *Cirsium supercanum* × *rivulare*, etc. etc. The participation of a particular variety may also be indicated. Example: *Salix caprea* × *daphnoides* var. *pulchra.*

Recommendation.

XVII. Half-breeds, or presumably such, may be designated by a name and a formula. Names of half-breeds are intercalated among the subdivisions of a species preceded by the sign ×. In the formula the names of the parents are in alphabetical order.

Section 4. The publication of names and the date of each name or combination of names.

Art. 35. Publication is effected by the sale or public distribution of printed matter or indelible autographs.

Communication of new names at a public meeting, or the placing of names in collections or gardens open to the public, do not constitute publication.

Examples. — Effective publication without printed matter: *Salvia oxyodon* Webb and Heldr. was published in July 1850 in an autograph catalogue and put on sale (Webb and Heldreich, *Catalogus plantarum hispanicarum, etc. ab A. Blanco lectarum*, Parisiis, Jul. 1850 in folio).— Non-effective publication at a public meeting: Cusson announced his establishment of the genus *Physospermum* in a memoir read at the Société des Sciences de Montpellier in 1773, and later in 1782 or 1783 at the Société de Médecine de Paris, but its effective publication dates from 1787, in the *Mémoires de la Soc. Roy. de Médecine de Paris*, vol. V, 1re partie.

Art. 36. On and after January 1, 1908, the publication of names of new groups will be valid only when they are accompanied by a latin diagnosis.

Art. 37. A species or a subdivision of a species, announced in a work, with a complete specific or varietal name, but without diagnosis or reference to a former description under another name, is not valid. Citation in synonymy or incidental mention of a name is not effective publication, and the same applies to the mention of name on a ticket issued with a dried plant without printed or autographed diagnosis;

Plates accompanied with analyses are equivalent to a description. but this applies only to plates published before January 1, 1908.

Examples.— The following are valid publications: *Onobrychis eubrychidea* Boiss. *Fl. or.* II, 546 (1872) published with description; *Panax nossibiensis* Drake in Grandidier *Hist. Phys. Nat. et Polit. de Madagascar,* Vol. XXXV, t. V, III, 5e part., Pl. 406 (1896), published in the form of a plate with analyses; *Cynanchum nivale* Nym. *Syll. fl. Eur.* 108 (1854–1855) published with a reference to *Vincetoxicum nivale* Boiss. et Heldr. previously described. *Hieracium Flahaultianum* Arv.-Touv. et Gaut., published in an exsiccata accompanied by a printed diagnosis (*Hieraciotheca gallica,* nos. 935–942, 1903).— The following are not valid: *Sciadophyllum heterotrichum* Decaisne et Planch. in *Rev. Hortic.*, ser. IV, III, 107 (1854), published without description or reference to a previous description under another name; *Ornithogalum undulatum* Hort. Berol. ex Kunth *Enum. pl.* IV, 348 (1843), quoted as a synonym of *Myogalum Boucheanum* Kunth l. c., the name adopted by the author, is not a valid publication; when transferred to *Ornithogalum*, this species must be called *Ornithogalum Boucheanum* Aschers. in *Osterr. Bot. Zeitschr.* XVI, 192 (1866); *Erythrina micropteryx* Poepp. quoted as a synonym of *Micropteryx Poeppigiana* Walp. in *Linnaea* XXIII, 740 (1850) is not a valid publication; the species in question, when placed in the genus *Erythrina* must be called *Erythrina Poeppigiana* O. F. Cook in *U. S. Dep. Agr.* Bull. no. 25, p. 57 (1901); *Nepeta Sieheana* Hausskn. which appears without diagnosis in an exsiccata (W. Siehe, Bot. Reise nach Cicilien, no. 521, 1896), is not valid.

Art. 38. A genus or any other group of higher rank than a species, named or announced without being characterised conformably to article 37 cannot be regarded as effectively published (*nomen nudum*). The mere indication of species as belonging to a new genus or of genera as belonging to a higher group, does not allow us to accept the genus or group in question as characterised and effectively published. An exception is made in the case of the generic names mentioned by Linnaeus in the *Species Plantarum* ed. 1., 1753, names which we associate with the descriptions in the *Genera Plantarum* ed. 5., 1754 (See article 19).

Examples. — The following are valid publications: *Carphalea* Juss. *Gen. Pl.* 198 (1789), published with a description; *Thuspeinanta* Dur. *Ind. Gen. Phaner.*, p. X (1888), published with a reference to the genus *Tapeinanthus*

Boiss. previously described; *Stipa* L. *Sp. Pl.* ed. 1, 78 (1753), valid because accompanied by a description in the *Genera Plantarum* ed. 5, no. 84 (1754).— The following are not valid: *Egeria* Neraud (*Bot. Voy. Freycinet*, p. 28 (1826), published without diagnosis or reference to a description previously made under another name; *Acosmus* Desv. mentioned incidentally as a synonym of the genus *Aspicarpa* Rich. by De Candolle (*Prodr.* 1, 583 [1824]); *Zatarhendi* Forsk. *Fl. Aeg. Arab.*, p. CXV (1775), based only on the enumeration of 3 species of the genus *Ocimum* without indication of characters.

Art. 39. The date of a name or of a combination of names is that of their effective publication. In the absence of proof to the contrary, the date placed on the work containing the name or combination of names is regarded as correct. On and after January 1st, 1908, the date of publication of the latin diagnosis only can be taken into account in questions of priority.

Examples. — *Mentha foliicoma* Opiz was distributed by its author in 1832, but the name dates from 1882 (published by Déséglise *Menth. Op.* in *Bull. soc. étud. scient. Angers*, 1881–1882, p. 210); *Mentha bracteolata* Op. *Seznam*, p. 65 (1852) without description, takes effect only from 1882, when it was published with a description (Déséglise l. c., p. 211). There is some reason for supposing that the first volume of Adanson's *Familles des Plantes* was published in 1762, but in absence of certainty the date 1763 on the title-page is assumed to be correct. The different parts of Willdenow's *Species Plantarum* were published as follows: vol. I, 1798; vol. II, 2, 1800; vol. III, 1, 1801; vol. III, 2, 1803; vol. III, 3, 1804; vol. IV, 2, 1806; and not in the years 1797, 1799, 1800, 1800, 1800 and 1805 respectively, as would appear from the title-page of the volumes: it is the earlier series of dates which takes effect. — The third volume of the *Prodromus florae hispanicae* of Willkomm & Lange, the title-page of which bears the date 1880, was published in four parts, pp. 1–240 in 1874, pp. 241–512 in 1877, pp. 513–736 in 1878, p. 737 to the end in 1880, and it is these dates which take effect.

Recommendations. Botanists will do well, in publishing, to conform to the following recommendations:

XVIII. Not to publish a name without clearly indicating whether it is the name of a family or a tribe, a genus or a section, a species or a variety; briefly, without expressing an opinion on the nature of the group to which they give the name.

XIX. To avoid publishing or mentioning in their publications unpublished names which they do not accept, especially if the persons responsible for these names have not formally authorised their publication (see Rec. XIV, *e*).

XX. When publishing new names in works written in a modern language (floras, catalogues etc.) to publish simultaneously the latin diagnoses which will make the names valid from the point of view of scientific nomenclature.

XXI. To give the etymology of new generic names and also of specific names when the meaning of the latter is not obvious.

XXII. To indicate precisely the date of publication of their works and that of the placing on sale or the distribution of named and numbered plants when these are accompanied by printed diagnoses. In the case of a work appearing in parts, the last published sheet of a volume should indicate the precise dates at which the different fascicles or parts of the volume were published, as well as the number of pages in each.

XXIII. When works are published in periodicals to require the editor to indicate on the separate copies the date (year and month) of publication and also the title of the periodical from which the work is extracted.

XXIV. Separate copies should always bear the pagination of the periodical of which they form a part; if desired they may also bear a special pagination.

Section 5. **On the precision to be given to names by the citation of the author who first published them.**

Art. 40. For the indication of the name or names of a group to be accurate and complete, and in order that the date may be readily verified, it is necessary to quote the author who first published the name or combination of names in question.

Examples: *Simarubaceae* Lindley, *Simaruba* Aublet, *Simaruba laevis* Grisebach, *Simaruba amara* Aublet var. *opaca* Engler.

Art. 41. An alteration of the constituent characters or of the circumscription of a group does not warrant the quotation of another author than the one who first published the name or combination of names.

When the changes have been considerable, the words: *mutatis charact.*, or *pro parte*, or *excl. gen.*, *excl. sp.*, *excl. var.*, or some other abridged indication, are added after the citation of the original author, according to the nature of the changes that have been made, and of the group in question.

Examples: *Phyllanthus* L. em. (emendavit) Müll. Arg.; *Myosotis* L. pro parte, R. Br.; *Globularia cordifolia* L. excl. var. β.; etc.

Art. 42. When a manuscript name has been published and referred to its author, the name of the person who published it should be appended to the citation. The same rule should be followed for names of garden origin when they are cited as "Hort."

Examples: *Capparis lasiantha* R. Br. ex or apud DC.; *Streptanthus heterophyllus* Nutt. in Torr. et Gray; *Gesnera Donklarii* Hort. ex or apud Hook. *Bot. Mag.* tab. 5070.

Art. 43. When, in a genus, a name is applied to a group which is moved into another group where it retains the same rank, or to a group which becomes of higher or lower rank than before, the change is equivalent to the creation of a new group and the author who has effected the change is the one to be quoted. The original author can be cited only in parenthesis.

Examples. — *Chieranthus tristis* L. when moved into the genus *Matthiola* becomes *Matthiola tristis* R. Br., or *Matthiola tristis* (L.) R. Br. — *Medicago polymorpha* L. var. *orbicularis* L. when raised to the rank of a species becomes *Medicago orbicularis* All. or *Medicago orbicularis* (L.) All.

Recommendations.

XXV. Authors' names put after names of plants are abbreviated, unless they are very short.

For this purpose preliminary particles or letters that do not, strictly speaking, form part of the name, are suppressed, and the first letters are given without any omission. If a name of one syllable is long enough to make it worth while to abridge it, the first consonants only are given (Br. for Brown); if the name has two or more syllables, the first syllable and the first letter of the following one are taken, or the two first when both are consonants (Juss. for Jussieu; Rich. for Richard). When it is necessary to give more of a name to avoid confusion between names beginning with the same syllables, the same system is to be followed. For instance two syllables are given together with the one or two first consonants of the third; or one of the last characteristic consonants of the name is added (Bertol. for Bertoloni, to distinguish from Bertero; Michx for Michaux, to distinguish from Micheli). Christian names or accessory designations, serving to distinguish two botanists of the same name, are abridged in the same way (Adr. Juss. for Adrien de Jussieu, Gaertn. fil. or Gaertn. f. for Gaertner filius).

When it is a well established custom to abridge a name in another manner, it is best to conform to it (L. for Linnaeus, DC. for De Candolle, St.-Hil. for Saint-Hilaire).

In publications destined for the general public and in titles it is preferable not to abridge.

Section 6. **On names that are to be retained when a group is divided, remodelled, transferred, or moved from one rank to another, or when two groups of the same rank are united.**

Art. 44. A change of characters, or a revision which involves the exclusion of certain elements of a group or the addition of new elements, does not warrant a change in the name or names of a group, except in cases provided for in article 51.

Examples.— The genus *Myosotis* as revised by R. Brown differs from the original genus of Linnaeus, but the name has not been changed, nor is any change allowable. Various authors have united with *Centaurea Jacea* L. one or two species which Linnaeus had kept distinct; the group thus constituted must be called *Centaurea Jacea* L. (sensu ampl.) or *Centaurea Jacea* L. (em. Visiani, em. Godron, etc.); the creation of a new name such as *Centaurea vulgaris* Godr. is superfluous.

Art. 45. When a genus is divided into two or more genera, the name must be kept and given to one of the principal divisions. If the genus contains a section or some other division which, judging by its name or its species, is the type or the origin of the group, the name is reserved for that part of it. If there is no such section or subdivision, but one of the parts detached contains a great many more species than the others, the name is reserved for that part of it.

Examples. — The genus *Helianthemum* contained, according to Dunal (in DC. *Prodr.* I. 266–284 [1824]), 112 well-known species distributed in nine sections; several of these sections have since been raised to generic rank (*Fumana* Spach, *Tuberaria* Spach) but the name *Helianthemum* has been kept for the divisions grouped round the section *Euhelianthemum*. — The genus *Convolvulus* L. em. Jacq. was divided into two by Robert Brown in 1810 (*Prodr. fl. Nov. Holl.*, p. 482–484), who gave the name *Calystegia* to one

of the genera which at that time contained only four species, and reserved the name *Convolvulus* for the other genus which contained a much larger number of species. — In the same way Salisbury (in *Trans. Linn. Soc.* VI, 317 [1802]), in separating *Erica vulgaris* L. from the genus *Erica*, under the name *Calluna*, kept the name *Erica* for the large number of species left.

Art. 46. When two or more groups of the same nature are united, the name of the oldest is retained. If the names are of the same date, the author chooses, and his choice cannot be modified by subsequent authors.

Examples. — Hooker f. and Thomson (*Fl. Ind.* p. 67 [1855]) united the genera *Wormia* Rottb. and *Capellia* Bl.; they gave the name *Wormia* to the genus thus formed because the last name dates from 1783 while *Capellia* dates from 1825. — In case of union of the two genera *Cardamine* and *Dentaria*, which were founded at the same time by Linnaeus (*Sp. Pl.* ed. 1, p. 653 and 654 [1753]; *Gen. Pl.* ed. 5, n. 726, 727) the collective genus must be called *Cardamine* because that name was chosen by Crantz (*Class. Crucif.*, p. 126 [1769]), who was the first to suggest the union.

Recommendations.

XXVI. Authors who have to choose between two generic names should note the following recommendations:

1. Of two names of the same date to prefer the one which was first accompanied by the description of a species.
2. Of two names of the same date, both accompanied by descriptions of species, to prefer the one, which, when the author made his choice, included the larger number of species.
3. In cases of equality from these various points of view to prefer the more correct and appropriate name.

XXVII. When several genera are united as subgenera or sections under one generic name, that subdivision which was first distinguished or described may retain its name (ex.: *Anarrhinum* sect. *Anarrhinum*; *Hemigenia* sect. *Hemigenia*), or be preceded by a prefix (*Anthriscus* sect. *Eu-Anthriscus*) or followed by a suffix (*Stachys* sect. *Stachyotypus*). These prefixes or suffixes lapse when the subdivisions are raised to generic rank.

XXVIII. When several species are united as subspecies or varieties under a collective name, that subdivision which was first distinguished or described may retain its name (ex.: *Saxifraga aspera* subsp. *aspera*) or bear a prefix (*Alchemilla alpina* subsp. *eualpina*) or be designated by some customary title (*normalis, genuinus, typicus, originarius, verus, veridicus* etc.). These prefixes or terms lapse when the subdivisions are raised to specific rank.

Art. 47. When a species or subdivision of a species is divided into two or more groups of the same nature, if one of the two forms was distinguished or described earlier than the other, the name is retained for that form.

Examples. — *Genista horrida* DC. *Fl. Franc.* IV. 500 was divided by Spach (in *Ann. Sci. Nat.* ser. 3, II., 253 [1844]) into three species: *G. horrida* DC., *G. Boissieri* Spach and *G. Webbii* Spach; the name *G. horrida* was rightly kept for the earliest described form, that described and figured by Vahl. and Gilibert.— Several species (*Primula cashmiriana* Munro, *P. erosa* Wall.) have been separated from *Primula denticulata* Sm. (*Exot. Bot.* II, 109, tab. 114), but the name *P. denticulata* has been rightly kept for the form which Smith described and figured under this name.

Art. 48. When a subgenus or section or species is moved into another genus, when a variety or other division of a species is moved into another species, retaining there the same rank, the original name of the subgenus or section, the first specific epithet, or the original name of the division of the species must be retained or must be re-established, unless, in the new position there exists one of the obstacles indicated in the articles of section 7.

Examples. — The subgenus *Alfredia* Less. (*Syn.* p. 6, 1832) of the genus *Rhaponticum* keeps its name when placed in the genus *Carduus*: *Carduus* sect. *Alfredia* Benth. et Hook. fil.; the section *Vaccaria* DC. of the genus *Saponaria* keeps its name when placed in the genus *Gypsophila*: *Gypsophila* sect. *Vaccaria* Gren. et Godr. — *Lotus siliquosus* L. *Syst.* ed. 10. p. 1178 (1759) when transferred to the genus *Tetragonolobus* must be called *Tetragonolobus siliquosus* Roth *Tent. Fl. germ.* I. 323 (1788) and not *Tetragonolobus Scandalida* Scop. *Fl. Carn.* ed. 2, II, 87 (1772). — *Betula incana* L. *Suppl.* p. 417 (1781) when transferred to the genus *Alnus* must be called *Alnus incana* Willd. *Sp. Pl.* IV, 335 (1805), not *Alnus lanuginosa* Gilib. *Exerc. Phytol.* II, 402 (1792).— *Satyrium nigrum* L. *Sp. Pl.* ed. 1, 944 (1753), when placed in the genus *Nigritella* must be called *Nigritella nigra* Reichb. f. *Ic. Fl. Germ. et Helv.* XIV, 102 (1851), not *Nigritella angustifolia* Rich. in *Mém. Mus. Par.* IV, 56 (1818). The variety γ *micranthum* Gren. et Godr. (Fl. France, I, 171 [1847]) of *Helianthemum italicum* Pers., when transferred as a variety to *H. penicillatum* Thib. retains its name: *H. penicillatum* var. α *micranthum* Grosser (in Engl. *Pflanzenreich.* Heft. 14, p. 115 [1903]).— The variety *subcarnosa* Hook. fil. (*Bot. Antarct. Voy.* I, 5 [1847]) of *Cardamine hirsuta* L., when transferred as a variety to *C. glacialis* DC., retains its name: *C. glacialis* var. *subcarnosa* O. E. Schulz (in Engl. *Bot. Jahrb.* XXXII, 542 [1903]); the citation of an earlier synonym (*Cardamine propinqua* Carmichael in *Trans. Linn. Soc.* XII, 507 [1818]) has no influence on the choice of the name of the variety (see art. 49). In all these cases, older but incorrect combinations must give place to more recent combinations in which the rule has been observed.

Art. 49. When a tribe becomes a family, a subgenus or a section becomes a genus, a subdivision of a species becomes a species, or the reverse of these changes takes place, and speaking generally when a group changes its rank, the earliest name (or combination of names) received by the group in its new position must be regarded as valid, if it is in conformity with the rules, unless there exist any of the obstacles indicated in the articles of section 7.

Examples. — The section *Campanopsis* R. Br. *Prodr. Fl. Nov. Holl.*, p. 561 (1810) of the genus *Campanula*, was first raised to generic rank by Schrader, and must be called *Wahlenbergia* Schrad. *Cat. hort. Goett.* (1814), not *Campanopsis* O. Kuntze *Rev. Gen.* II, p. 378 (1891). — *Magnolia virginiana* L. var. *foetida* L. *Sp. pl.* ed. 1, p. 536 (1753), raised to specific rank, must be called *Magnolia grandiflora* L. *Syst. Nat.* ed. 10, p. 1082 (1759) not *Magnolia foetida* Sarg. in *Gard. and For.* II, 615 (1889). – *Mentha spicata* L. var. *viridis* L. *Sp. Pl.*, ed. 1, p. 576 (1753) was raised to the rank of a species by Hudson, and must be called *Mentha spicata* Huds. *Fl. angl.* ed. 1, p. 221 (1762) not *Mentha viridis* L. *Sp. Pl.*, ed. 2, p. 804 (1763). — *Lythrum inter-*

medium Ledeb. (*Ind. Hort Dorp.* [1822]), regarded as a variety of *L. Salicaria* L., must be called *L. Salicaria* var. *gracilius* Turcz. (in *Bull. Soc. Nat. Moscou*, XVII, 235 [1844]), not *L. Salicaria* var. *intermedium* Koehne (in Engl. *Bot. Jahrb.* I, 327 [1881]). In all these cases names which are in accordance with the old law of Alphonse de Candolle must give place to older names and combinations.

Recommendations. Authors who make the changes discussed in article 49 should note the following recommendations in order to avoid a change of name in case of a change of rank.

XXIX. 1⁰. When a sub-tribe becomes a tribe, when a tribe becomes a subfamily, when a subfamily becomes a family, etc., or when the inverse changes occur, do not alter the root of a name but only the termination (*-inae, -eae, -oideae, -aceae, -ineae, -ales*, etc.), unless, in the new position one of the obstacles indicated in the articles of section 7, supervenes, or the new designation becomes a source of error, or there is some other serious reason against it.

2⁰. When a section or a subgenus becomes a genus, or the inverse changes take place, retain the old names, unless this results in two genera of plants having the same name, or the existence of two subdivisions of the same name in the same genus, or one of the obstacles indicated in the articles of section 7 supervenes.

3⁰. When a subdivision of a species becomes a species or the inverse change occurs, retain the original epithets, unless this results in two species bearing the same name in the same genus, or two subdivisions bearing the same name in the same species, or unless any of the obstacles indicated in section 7 supervenes.

Section 7. **On names that are to be rejected, changed or modified.**

Art. 50. No one is authorised to reject, change or modify a name (or combination of names) because it is badly chosen, or disagreeable, or another is preferable or better known, or because of the existence of an earlier homonym which is universally regarded as non-valid, or for any other motive either contestable or of little import. (See also art. 57.)

Examples. — This rule was broken by the change of *Staphylea* to *Staphylis*, *Tamus* to *Thamnos*, *Mentha* to *Minthe*, *Tillaea* to *Tillia*, *Vincetoxicum* to *Alexitoxicon*; and by the change of *Orobanche Rapum* to *O. sarothamnophyta*, *O. Columbariae* to *O. columbarihaerens*, *O. Artemisiae* to *O. artemisiepiphyta*. All these modifications (which are contrary to Art. 50) must be rejected.— The name *Diplomorpha* Meissn. in *Regensb. Denkschr.* III, 289 (1841) must not be substituted for the generic name *Wickstroemia Endl. Prodr. fl. Norfolk.*, p. 47 (1833) because of the earlier homonyms *Wi(c)kstroemia* Schrad. *Goett. gel. Anz.*, p. 710 (1821) and *Wi(c)kstroemia* Spreng. in *Vet. Akad. Handl. Stockh.* 1821, p. 167, t. 3, for the former is merely a synonym of the genus *Laplacea* Kunth (1821) and the latter of a subdivision of the genus *Eupatorium* L. (1753).

Recommendations. See on the subject of homonyms recommendations V*b* and XIV*f* which suggest that cases of this kind should be avoided for the future.

Art. 51. Every one should refuse to admit a name in the following cases:

1. When the name is applied in the plant kingdom to a group which has an earlier valid name.

2. When it duplicates the name of a class, order, family or genus, or a subdivision or species of the same genus, or a subdivision of the same species.

3. When it is based on a monstrosity.

4. When the group which it designates embraces elements altogether incoherent, or when it becomes a permanent source of confusion or error.

5. When it is contrary to the rules of sections 4 and 6.

Examples. — 1°. *Carelia* Adans. (1763) is a name which was applied by its author to a genus which had already received a valid name (*Ageratum* L. [1753]) (*synonym*); similarly *Trichilia alata* N. E. Brown (in *Kew Bull.* [1896] p. 160) is a name which cannot be maintained because it is a synonym of *T. pterophylla* C. DC. (in *Bull. Herb. Boiss.* II, 581 [1894]).— 2°. *Tapeinanthus*, a name given by Boissier to a genus of Labiatae was replaced by *Thuspeinanta* by Th. Durand, because of the existence of an earlier and valid genus, *Tapeinanthus* Herb. among the Amaryllidaceae (*homonym*). Similarly *Astragalus rhizanthus* Boiss. (*Diagn. Pl. Or.* ser. 1, II, 83 [1843]) was renamed *A. cariensis* Boiss. because of the existence of an earlier valid homonym, *Astragalus rhizanthus* Royle *Illustr. Bot. Himal.* p. 200 (1835). — 4°. The genus *Uropedium* Lindl. was based on a monstrosity which is now referred to *Phragmopedilum caudatum* Rolfe. — 5°. The genus *Schrebera* L. derives its characters from the two genera *Cuscuta* and *Myrica* (parasite and host) and must be dropped; and the same applies to *Lemairea* De Vr. which is made up of elements taken from different families. Linnaeus described under the name of *Rosa villosa* a plant which has been referred to several different species and of which certain identification seems impossible; to avoid the confusion which results from the use of the name *Rosa villosa*, it is preferable in this case, as in other analogous cases, to abandon the name altogether.

Art. 52. The name of an order, suborder, family or subfamily, tribe or subtribe, must be changed when it is taken from a genus which, by general consent, does not belong to the group in question.

Examples. — If it were to be shown that the genus *Portulaca* does not belong to the family *Portulacaceae*, the name *Portulacaceae* would have to be changed. — Nees (in Hooker and Arnott, *Bot. Beechey's Voy.* p. 237 [1836]) gave the name *Tristegineae* to a tribe of Gramineae, after the genus *Tristegis* Nees (a synonym of the genus *Melinis* Beauv.). But *Melinis* (*Tristegis*) having been excluded from this tribe by Stapf (in *Fl. Cap.* VII. 313) and by Hackel (in *Oesterr. bot. Zeitcshr.* LI, 464), these authors have adopted the name *Arundinelleae* from the genus *Arundinella*.

Art. 53. When a subgenus, a section or a subsection, passes as such into another genus, the name must be changed if there is already, in that genus, a valid group of the same rank, under the same name.

When a species is moved from one genus into another, its specific epithet must be changed if it is already borne by a valid species of that genus. Similarly when a subspecies, a variety, or some other subdivision of a species is placed under another species, its name

must be changed if borne already by a valid form of like rank in that species.

Examples.— *Spartium biflorum* Desf. (1798–1800) when transferred by Spach in 1849 into the genus *Cytisus* could not be called *Cytisus biflorus*, but was renamed *Cytisus Fontanesii*, because of the previous existence of a valid species *Cytisus biflorus* L'Hérit. (1789). The earliest synonym of *Calochortus Nuttallii* Torr. et Gray (in *Pacific Rail. Rep.* II, 124 [1855–1856]) is *Fritillaria alba* Nutt. (*Gen. Amer.* I, 222 [1818]) but we cannot restore the original epithet of this species, although this has been done in the *Notizbl. des K. bot. Gartens und Mus. Berl.* II, 318 (1899), because there exists already a valid species in the genus with the name *Calochortus albus* Dougl. in Maund *Botanist* t. 98 (1839).

Art. 54. Names of genera must be rejected in the following special cases:

1. When they are formed from a technical term borrowed from morphology, unless they are accompanied by specific names.
2. When they express uninominal nomenclature.
3. When they are formed of two words, unless these two words were from the first united or joined by a hyphen

Examples.— 1°. Generic names such as *Lignum*, *Radix*, *Spina*, etc. would not now be admissible; on the other hand a generic name like *Tuber* should not be rejected when it has been published with specific names (*Tuber cibarium* etc.).— 2°. Ehrhart (*Phytophylacium* [1780] and *Beiträg.* IV, 145–150) made use of a uninominal nomenclature for species known at that time under binary names (*Phaeocephalum*, *Leptostachys*, etc.). These names, which resemble generic names, must not be confused with such and are to be rejected, unless a subsequent author has given them the value of a generic name: for example *Baeothryon*, a uninominal expression of Ehrhart's, has been applied to a genus characterised by A. Dietrich *Spec. Pl.* II, 89 (1833).— 3°. Names like *Quisqualis* (a single word from the first), *Sebastiano-Schaueria* and *Neves-Armondia* will stand.

Art. 55. Specific names must also be rejected in the following special cases:

1°. When they are ordinals serving for purpose of enumeration.

2°. When they merely repeat the generic name.

Examples.— 1°. *Boletus vicesimus sextus*, *Agaricus octogesimus nonus*.— 2°. *Linaria Linaria*, *Raphanistrum Raphanistrum* etc.

Art. 56. In the cases foreseen in articles 51 to 55, the name to be rejected or changed is replaced by the oldest valid name in the group in question, and in default of such a one a new name must be made.

Examples: See the examples cited under articles 51 and 53.

Art. 57. The original spelling of a name must be retained, except in case of a typographic or orthographic error. When the difference

between two names, especially two generic names, lies in the termination, these names are to be regarded as distinct even though differing by one letter only.

Examples: *Rubia* and *Rubus*, *Monochaete* and *Monochaetum*, *Peponia* and *Peponium*, *Iria* and *Iris*.

Recommendations.

XXX. The liberty of making orthographic corrections must be used with reserve, especially if the change effects the first syllable, and above all the first letter of a name.

XXXI. Many names differ by a single letter without risk of confusion (ex. *Durvillea* and *Urvillea*). In cases where a close approach to identity is a source of error (ex. *Astrostemma* and *Asterostemma* in one and the same family, *Asclepiadaceae*, *Pleuripetalum* and *Pleuropetalum* in *Orchidaceae*) only one, the older, of the names should be kept, in accordance with article 51, 4⁰.

Chapter IV. **Modifications of the rules of botanical nomenclature.**

Art. 58. The rules of botanical nomenclature can only be modified by competent persons at an international Congress convened for the express purpose.

Appendix. **Various Recommendations.**

XXXII. Botanists should use in modern languages latin scientific names or those immediately derived from them, preferably to names of another kind or origin. They should avoid the use of the latter unless these are very clear and in common use.

XXXIII. Every friend of Science should oppose the introduction into a modern language of names of plants which are not already there, unless they are derived from latin botanical names by means of some slight alteration.

XXXIV. The metric system only is used in botany for reckoning weights and measures. The foot, inch, line, pound, ounce etc. should be rigorously excluded from scientific language.

Altitude, depth, rapidity etc. are measured in metres. Fathoms, knôts, miles etc. are expressions which should disappear from scientific language.

XXXV. Very minute dimensions are reckoned in μ (micromillimetres, microns, or thousandths of a millimetre) and not in fractions of a millimetre or line, etc.; fractions encumbered with ciphers and commas are more likely to give rise to mistakes.

XXXVI. Authors are asked to indicate clearly and precisely the scale of the figures which they publish.

XXXVII. Temperatures are expressed in degrees of the centigrade thermometer of Celsius.

New England Genera of which the long established Names are to be maintained notwithstanding technical Lack of Priority.

(Extracted from a list of about 400 such generic names sanctioned by act of the International Botanical Congress at Vienna.)

Names to be retained	Names to be discarded.
Tragus [Hall. (1768)] Scop. (1777)	Nazia Adans. (1763)
Leersia Sw. (1788)	Homalocenchrus Mieg (1760)
Hierochloe [J. G. Gmel. (1747)] R. Br. (1810)	Savastana Schrank (1789)
	Torresia Ruiz & Pav. (1794)
	Dissarrenum Labill. (1806)
Cynodon L. C. Rich. (1805)	Capriola Adans. (1763)
	Dactilon Vill. (1789)
	Fibichia Koel. (1802)
Ctenium Panz. (1814)	Campulosus Desv. (1810)
Glyceria R. Br. (1810)	Panicularia Fabr. (1763)
Fimbristylis Vahl (1806)	Iria L. C. Rich. (1805)
	Iriha O. Ktze. (1891)
Rhynchospora Vahl (1806)	Triodon L. C. Rich. (1805)
Symplocarpus Salisb. (1818)	Spathyema Raf. (1808)
Heteranthera Ruiz & Pav. (1794)	Phrynium Loefl. (1758)
Luzula DC. (1805)	Juncoides [Moehr. ex] Adans. (1763)
Smilacina Desf. (1807)	Vagnera Adans. (1763)
	Tovaria Neck. (1790)
	Polygonastrum Moench (1794)
Majanthemum Web. (1780)	Unifolium [Moehr. (1736)] Adans. (1763)
	Valentinia Heist. (1763)
Lachnanthes Ell. (1816)	Heritiera J. F Gmel. (1791)
	Gyrotheca Salisb. (1812)
Belamcanda Adans. (1763)	Gemmingia Heist. (1763)
Platanthera L. C. Rich. (1818)	Lysias Salisb. (1812)
Spiranthes L C. Rich (1818)	Gyrostachis Pers. (1807)
	Ibidium Salisb. (1812)
Listera R. Br. (1813)	Diphryllum Raf. (1808)
Calopogon R. Br. (1813)	Cathea Salisb. (1812)
Liparis L. C. Rich.	Leptorkis Thou. (1809)
Carya Nutt. (1818)	Scoria Raf. (1808)
	Hicorius Raf. (1817)
	Hicoria Raf. (1838)

Maclura Nutt.	Toxylon Raf. (1817)
	Joxylon Raf. (1818)
Laportea Gaudich. (1826)	Urticastrum Fabric. (1759)
Pilea Lindl. (1821)	Adicea Raf. (1815)
Arceuthobium Marsch.-Bieb. (1819)	Razoumowsk a Hoffm. (1808)
Fagopyrum [Tourn. ex] Moench (1794)	Helxine L. (1753)
Suaeda Forsk. (1775)	Dondia Adans. (1763)
	Lerchea [Hall. (1743)] Rueling (1774)
Spergularia J. & C. Presl. (1819)	Buda Adans. (1763)
	Tissa Adans. (1763)
Dicentra Bernh. (1833)	Capnorchis Borckh. (1797)
	Bikukulla Adans. (1763)
	Diclytra Borckh. (1797)
	Dielytra Cham. & Schlechtd. (1826)
	Dactylicapnos Wall. (1826)
Corydalis Medik. (1803)	Capnoides Adans. (1763)
	Cisticapnos Adans. (1763)
	Neckeria Scop. (1777)
	Pseudofumaria Medik. (1789)
Capsella Medik. (1792)	Bursa Siegesb. Weber (1780)
	Marsypocarpus Neck (1790)
Erophila DC. (1821)	Gansblum Adans. (1763)
Physocarpus Maxim. (1879)	Opulaster Medik. (1799)
Sorbaria A. Br. (1864)	Basilima Raf. (1836)
	Schizonotus Lindl. (1829)
Tetragonolobus Scop. (1772)	Scandalida Adans. (1763)
Tephrosia Pers. (1807)	Cracca L. (1747, 1753)
	Colinil Adans. (1763)
	Needhamia Scop. (1777)
Oxytropis DC. (1802)	Spiesia Neck. (1790)
Desmodium Desv. (1813)	Meibomia Adans. (1763)
	Pleurolobus J. St. Hil. (1812)
Amphicarpaea Ell. (1818)	Falcata J. F. Gmel. (1791)
	Savia Raf. (1808)
Ailanthus Desf. (1789)	Pongelion Adans. (1763)
Nemopanthus Raf. (1819)	Ilicioides Dumont de Courset. (1802)
Shepherdia Nutt. (1818)	Lepargyrea Raf. (1818)
Bifora Hoffm. (1816)	Anidrum Neck. (1790)
Cryptotaenia DC. (1829)	Deringa Adans. (1763)
	Alacospermum Neck. (1790)
Loiseleuria Desv. (1840)	Chamaecistus Oeder. (1761)
Gaylussacia HBK. (1818)	Adnaria Raf. (1817)

Halenia Borkh. (1796)	Tetragonanthus S. G. Gmel. (1769)
Calystegia R. Br. (1810)	Volvulus Medik. (1791)
Ellisia L. (1763)	Macrocalyx Trew (1761)
Amsinckia Lehm. (1831)	Benthamia Lindl. (1830)
Mertensia Roth. (1797)	Pneumaria Hill (1764)
Pycnanthemum L. C. Rich. (1803)	Furera Adans. (1763)
	Koellia Moench (1794)
Nicandra Adans. (1763)	Pentagonia Heist. ex Fabr. (1759)
	Physaloides Boehm. (1760)
Epiphegus Nutt. (1818)	Leptamnium Raf. (1818)
Fedia Moench (1794)	Mitrophora Neck. (1790)
Echinocystis Torr. & Gray (1840)	Micrampelis Raf. (1808)
Vernonia Schreb. (1791)	Behen Hill (1762)
Mikania Willd. (1803–1804)	Willugbaeya Neck. (1790)
	Carelia Cav. (1802)
Liatris Schreb. (1791)	Laciniaria Hill (1762)
	Psilosanthus Neck. (1790)
Chrysopsis Ell. (1824)	Diplogon Raf. (1818)
Haplopappus Cass. (1828)	Hoorebeckia Cornelissen (1817)
Silybum Adans. (1763)	Mariana Hill (1762)
Cnicus Gaertn.[1] (1791)	Carbenia Adans. (1763)
Krigia Schreb. (1791)	Adopogon Neck. (1790)
Taraxacum Wiggers (1780)	Hedypnois Scop. (1772)

[[1] It should be noticed that this ruling is to the effect that the name *Cnicus*, employed by Linnaeus for a considerable aggregate, should be restricted, as by Gaertner, to *Cnicus benedictus* and any plants regarded as congeneric with it. As a result our ordinary thistles with plumose pappus may bear the name *Cirsium* Adans., and the species with simple pappus the name *Carduus* L. The degree to which the latter groups may be regarded as separate genera is of course still a matter of individual opinion.— Ed.]

NOTES ON NEW ENGLAND HEPATICAE, —V.

Alexander W. Evans.

(Plate 73.)

Of the species noted below the first three are introduced for nomenclatorial reasons. The paper also records additions to the hepatic flora of each New England state except Rhode Island. The majority of these additions belong to either *Lophozia* or *Calypogeia*, one species in the latter genus being elevated from varietal rank. For the sake of comparison the two species of *Calypogeia* already known from New England are also discussed. The reasons for discarding the generic name *Kantia* in favor of *Calypogeia* are stated by the writer in another connection.[1]

1. **Ricciella Sullivantii** (Aust.) comb. nov. *Riccia Sullivantii* Aust. Proc. Acad. Nat. Sci. Phil. 1869: 233. *Riccia fluitans*, var. *Sullivantii* Aust.; Underwood, Bull. Illinois State Lab. Nat. Hist. **2**: 28. 1884. *Riccia Huebeneriana* Underw. Bot. Gazette **19**: 276. 1894 (not Lindenb.). The genus *Ricciella* was proposed by A. Braun in 1821[2] for the reception of *Riccia fluitans* L. and *Riccia canaliculata* Hoffm., both of which are now considered forms of the same species. It was based on the fact that the capsules protruded from the lower surface of the thallus, instead of from the upper, as in more typical species of *Riccia*. For a long time it received but slight recognition, although both Trevisan and Dumortier accepted it without question. It has also been accepted by Stephani, at first as a genus and afterwards as a subgenus under *Riccia*.[3] Instead, however, of relying upon the original characters of Braun, he bases his division on differences in the structure of the thallus. In *Riccia* proper, as he defines it, the photosynthetic layer consists of rows of cells extending at right angles to the epidermis; these are loosely connected longitudinally and enclose air chambers in the form of narrow canals. In *Ricciella* the air chambers are more irregular and are separated by plates of cells. Warnstorf[4] adopts *Ricciella* as a genus on the basis of Stephani's characterization, a procedure which seems to be entirely

[1] Bryologist **10**: 24–30. 1907.
[2] Flora **4**: 756. 1821.
[3] Bull. de l'Herb. Boissier I. **6**: 361. 1898.
[4] Kryptogamenfl. der Mark Brandenburg **1**: 80. 1903.

warranted. In addition to *R. Sullivantii* two other species of *Ricciella* are known from New England, namely, *R. crystallina* (L.) Warnst. and the type of the genus, *R. fluitans* (L.) A. Br. *R. crystallina* has been found in Connecticut only, but the other two have been reported from each New England state except New Hampshire.

2. **Marsupella Sullivantii** (DeNot.) comb. nov. *Sarcoscyphus sphacelatus*, var. *medius* Gottsche (in part), 1860. *S. Sullivantii* De Not., 1861. *S. Ehrharti*, var. *erythrorhizus* Limpr., 1876. *Marsupella erythrorhiza* Schiffn., 1901. *M. media* Schiffn. (as synonym), 1901.[1] The 49th Article of the Vienna Rules of Nomenclature[2] includes the following statement: when....a subdivision of a species becomes a species....the earliest name received by the group in its new position must be regarded as valid. Applying this rule to the present species it is perfectly evident that *Sarcoscyphus Sullivantii* was the earliest name received by Gottsche's var. *medius* of *S. sphacelatus*, upon its elevation to specific rank. The name *Sullivantii* must therefore be regarded as valid and must be retained when the species is transferred to *Marsupella*. Precisely the same conclusion would be reached by applying the American Association Code of Botanical Nomenclature as recently revised. Specimens of *M. Sullivantii* have recently been received from various localities in the White Mountains, New Hampshire (*W. G. Farlow*), and from Southington, Connecticut (*Miss Lorenz*). It has not yet been reported, however, from either Vermont or Rhode Island.

3. Nardia Geoscyphus (De Not.) Lindb.; Carrington, British Hepat. 27. 1874. *Jungermannia scalaris β minor* Nees, Naturgeschichte der europ. Leberm. **1**: 281. 1833. *Alicularia scalaris β minor* Nees, l. c. **2**: 449. 1836. *Jungermannia haematosticta* Nees, l. c. **2**: 453 (in note). 1836. *Alicularia Geoscyphus* De Not. Mem. R. Accad. Sci. di Torino II. **18**: 486. *f. III (1–13)*. 1859. *Jungermannia Silvrettae* Gottsche; G. & R. Hep. Eur. Exsic. *470*. 1869 (without description). *Nardia repanda* Lindb.; Carrington, British Hepat. 27. 1874 (not *Jungermannia scalaris β repanda* Hüben. Hep. Germ. 81. 1834). *Marsupella Silvrettae* Dumort. Hep. Europ. 128. 1874. *Alicularia minor* Limpr.; Cohn, Kryptogamenfl. von Schlesien **1**: 251. 1876. *Nardia haematosticta* Lindb. Musc. Scand. 8. 1879.

[1] For fuller references and additional synonyms see the writer's earlier notes on *Marsupella media* in Rhodora **6**: 167. 1904.

[2] International Rules of Botanical Nomenclature adopted by the International Botanical Congress of Vienna 1905. Jena, 1906.

N. insecta Lindb. l. c. *Jungermannia dovrensis* Limpr. Jahresb. Schlesischen Ges. für vaterl. Cultur **61**: 10. 1884. *Nardia minor* Arn. Lebermoosstudien im nordl. Norwegen 39. 1892. *N. Silvrettae* Pears. Hepat. British Isles 372. *pl. 172.* 1901. *Mesophylla minor* Corb.; Bouvet, Bull. Soc. d'Étud. Scient. d'Angers for 1902: 189. 1903. Judging from the above synonymy the specific name *haematosticta* is apparently available for the present species, and Lindberg's combination *Nardia haematostictà* has been rather extensively adopted.[1] *Jungermannia haematosticta* Nees, however, was never effectively published by its author, according to either the Vienna Rules or the Association Code, both of which state that incidental mention of a name is not publication. The note referred to in which the name appears is given under *Alicularia scalaris β minor* and states that Nees von Esenbeck had formerly sent specimens of this variety to his friends under the name *Jungermannia haematosticta*. This cannot be considered as anything more than incidental mention, even though the implication is made that the plant might perhaps be regarded as worthy of specific rank. The name must therefore be discarded, and the species must bear the later name *Geoscyphus* of De Notaris, according to the 49th Article of the Vienna Rules. As originally proposed this name had a substantive form and did not agree in gender with the generic name *Alicularia*. Some of the later writers who have used it have changed it to an adjective form, but this course can hardly be warranted. It should also be noted that Trevisan[2] published the combination *Nardia Geoscyphus* in the same year as Lindberg, but apparently later in the year because Massalongo[3] quotes Lindberg rather than Trevisan as the author of the name. According to Stephani[2] *Alicularia Rotaeana* De Not. (Mem. R. Accad. Sci. di Torino II. **18**: 484. *f. II* [*1–14*]. 1859) is also a synonym of the present species,[2] but Massalongo[4] considers it a form of *Nardia scalaris* (Schrad.) S. F. Gray instead, and the figures of De Notaris certainly give strong support to this latter view. *Nardia Geoscyphus* was first recorded as a New England plant from specimens collected along the Crawford Bridle Path in the White Mountains. It has

[1] A full description of the species under this name was published by the writer in Proc. Wash. Acad. **2**: 296. 1900. See also RHODORA **4**: 209. 1902; and **5**: 172. 1903.

[2] Rend. R. Ist. Lomb. di Sci. e Lett. II. **2**: 784. 1874.

[3] Ann. R. Ist. Bot. di Roma **3**: (5). 1888.

[4] Bull. de l'Herb. Boissier II. **2**: 40. 1902.

since been found at Franconia, New Hampshire (*W. G. Farlow*), and at West Newbury, Massachusetts (*Miss Haynes*). The lowland specimens bear leaves which are more or less bilobed and therefore represent the *Nardia insecta* of Lindberg. European writers, however, do not consider this plant a distinct species at the present time.

4. Lophozia confertifolia Schiffn. Oesterr. Bot. Zeitschr. **55**: 47. 1905. Mt. Katahdin, Maine (*Cowles Party, 20*). Determination confirmed by Schiffner.[3] The species is apparently confined to alpine regions, where it grows on peaty soil or on stones covered with earth. Until the present time it was known from only four European localities, three in Austria and one in Switzerland, and its detection in New England is therefore of considerable interest. *L. confertifolia* belongs to the *ventricosa*-group, and its author compares it with *L. alpestris* (Schleich.) Evans and *L. Wenzelii* (Nees) Steph. It is characterized by its densely tufted habit and by the fact that its leaves are closely imbricated and concave. Its color is a dull green, more or less tinged with brown or red. The leaves are broadly elliptical and bifid one third or less with a lunulate to obtuse sinus and broad obtuse or subacute lobes. The leaf-cells have small but distinct triangular trigones and their walls are otherwise thin though often pigmented. In the middle of the leaf the cells average about 23 μ in diameter, agreeing in this respect with the cells in *L. ventricosa* but being considerably larger than those of *L. alpestris.* The Maine specimens agree closely with those distributed by Schiffner.

5. Lophozia longidens (Lindb.) Macoun, Cat. Canadian Pl. **7**: 18. 1902. *Jungermannia porphyroleuca* Γ *attenuata* Nees, Naturgeschichte der europ. Leberm. **2**: 80. 1836. *Jungermannia longidens* Lindb. Musc. Scand. 7. 1879. Streaked Mountain, Hebron, Maine (*J. A. Allen, 5*). Chocorua (Whidden's Pond), Mt. Adams and Mt. Pemigewasset, New Hampshire (*W. G. Farlow*). The Chocorua specimens were determined by Schiffner. *L. longidens* was first recorded as a North American species by Macoun, who found it on wet rocks in the Smoky Mountains of Cape Breton, Nova Scotia. It has a wide distribution in Europe and has also been collected in Siberia. Schiffner considers it one of the most clearly marked members of the *ventricosa*-group, but Stephani looks upon it as a simple synonym of *L. ventricosa.* The writer is disposed to accept

[3] See Oesterr. Bot. Zeitschr. **56**: 26. 1906. Both the present species and the following are here recorded from New England for the first time.

the opinion of Schiffner. *L. longidens* grows in rather loose tufts and is either dull green in color or more or less tinged with brown or yellow. It is more delicate in texture than most of its allies, the leaf-cells being thin-walled except for their minute trigones. The leaves are ovate-quadrate or ovate-rectangular in outline and are bifid one third or less with an obtuse sinus. The divisions of the leaves are narrowly triangular and acute, rarely diverging from each other to any extent. The species rarely fruits but usually develops gemmiparous branches which are among its most striking features. These branches are ascending or erect and their crowded leaves are almost transversely attached. They spread obliquely from the axis but are frequently squarrose in the outer part. The gemmae are borne in small clusters at the tips of the lobes; they are globoid or short-ellipsoid in form, sometimes with obscure angles, and are either unicellular or bicellular. In color the gemmae are normally reddish brown, but the New Hampshire specimens bear green gemmae and Schiffner states that he has observed a similar condition among European specimens. Probably the lack of pigmentation in these cases is due to the fact that the plants were deeply shaded. *L. longidens* seems to attain its best development on rocks but it also occurs on logs; it is apparently confined to alpine or subalpine localities.

(*To be continued.*)

QUERCUS PRINOIDES WILLD. VAR. RUFESCENS VAR. NOV.

Alfred Rehder.

In the spring of 1903 Mr. F. G. Floyd drew my attention to a peculiar shrubby Oak he had discovered the year before on the island of Nantucket. I subsequently visited the island myself and found the shrub in question in the locality indicated by Mr. Floyd. It grows there in the low thickets of Scrub Oak consisting of *Quercus prinoides* and *ilicifolia* and covering a large part of the higher rolling land between Nantucket and Siasconset, but occurs only as scattered bushes between the other Oaks. In general appearance it resembles most the *Q. prinoides*, but differs in the villous and rufous or rather fulvous pubescence which covers the under side of the leaves and

the young branches. This pubescence and the locality suggested at first sight a possible cross between *Q. prinoides* and *ilicifolia*, but as all the other characters of the form are those of *Q. prinoides*, this idea had to be abandoned; moreover, no cross has as yet been observed between a Black and a White Oak. No mention of a *Q. prinoides* with the pubescence described could be found in literature, but in looking through the Gray Herbarium and the herbaria of the Arnold Arboretum and of the New England Botanical Club I found at least two specimens which undoubtedly belonged to this form, one from Cape Cod and one from the Pine barrens of New Jersey so that it may be considered a coast form of *Q. prinoides*, and as it differs also in a few other characters from the type, it seems to deserve a varietal designation and may be distinguished as

QUERCUS PRINOIDES Willd. var. **rufescens** var. nov.

A typo recedit foliis subtus non solum albo-tomentosis sed etiam fulvescenti-villosis praecipue secus costam mediam ramulisque hornotinis fulvescenti-pubescentibus, foliorum lobis acutiusculis mucrone calloso instructis, etiam foliis obovatis quam ea formi typici omnino minoribus et latioribus saepe undulatis.

The variety differs from the type in the leaves having beneath besides the close white tomentum a woolly yellowish pubescence particularly along the m drib and in the branches being pubescent at least when young. The leaves are generally smaller are broader and obovate with acutish callous-tipped lobes and often undulate margin.

MASSACHUSETTS: Nantucket Island, between Nantucket and Siasconset, Sept. 1902, *F. G. Floyd*; August 29, 1903, *Alfred Rehder*; Cape Cod, Centreville, damp woods, July 14, 1903, *Clara Imogene Cheney*; NEW JERSEY: Pine barrens of Manchester, August 26, 1852, *A. C. Hexamer*. The following specimens must also be referred to this variety, though they are somewhat deviating from its type. New Jersey, Pine barrens (Herb. Gray) differs in its larger leaves; Massachusetts, Jamaica Plain, 1887, *C. E. Faxon*, has leaves with a slighter villous pubescence; North Carolina, Dunsmore, Buncombe Co., September 21, 1897, *Biltmore Herb.* No. 828^b, has less villous and longer and narrower leaves and comes from the mountains of western North Carolina.

The typical *Quercus prinoides* has the generally larger and often oblong-obovate or even oblong leaves more gradually narrowed toward the apex and covered beneath with a close whitish tomentum, which is sometimes reduced to scattered stellate hairs; the branchlets

are glabrous. Intermediate forms between the species and the variety are in Nantucket always associated with plants representing the type of the variety.

Arnold Arboretum.

AN INTERESTING LOCALITY.

E. B. Harger.

Pistapaug (or Paug) Pond is a natural pond of manifest glacial origin, about three-fourths of a mile long and a third as broad lying at the intersection of the four towns of North Branford, Guilford, Wallingford and Durham about twelve miles northeasterly from New Haven, Connecticut. It is mostly within the limits of Wallingford and Durham about one-half in each. On the east of the pond (the Durham side), one of the characteristic trap-ridges of the region, known as Pistapaug Mountain rises from the water's edge more than 200 feet above the pond which itself is at an elevation of some 400 feet above sea level. To the northwest is another trap hill; and a highway skirts closely the northern border of the pond and runs through the pass between the two hills. Westward is a broad tract of cleared land and to the south lie low wooded hills, where doubtless runs the old valley now dammed with glacial drift.

In the spring of 1903 I found in the Eaton Herbarium at New Haven a specimen of *Polymnia Canadensis* L., collected in 1880 by Prof. O. D. Allen and labeled "Trap slide near Paug Pond, Durham, "Conn." I immediately formed the resolution of exploring the region, but had no opportunity of doing so until Sept. 15, 1905. On this trip, almost at the first sight of a "trap slide" I found the *Polymnia*, but on the Wallingford side of the pond. However, on crossing to the slopes of Pistapaug Mountain I found the plant in great abundance, both near the foot and near the top of the talus-slope, which here runs directly into the water. The remoteness of the locality from houses and the extent of territory over which the plant is spread seem to indicate that is not of recent introduction, but may be considered native to Connecticut.

Although the main object of the trip was fulfilled by the re-discovery of *Polymnia*, the further results were very gratifying. At the base

of the mountain, east of the head of the pond, were found two small patches of *Arenaria macrophylla* Hook., the second station in the state. Mr. Bartlett's station (RHODORA **7**: 20) is five or six miles distant. Near the *Arenaria* grow *Phegopteris Dryopteris* Fée. and *Stellaria borealis* Bigelow, and a short distance south I found a quantity of *Pyrus Americana* DC. in full fruit, perhaps the most southerly station in the state. From the pond itself I collected *Bidens Beckii* Torr., *Potamogeton praelongus* Wulf. and *Heteranthera graminea* Vahl., the last in good flower. By the roadside, perhaps one-fourth of a mile west, a colony of *Cuphea viscossissima* Jacq. reached the best development that I have noted in this state.

As on the first trip I had only about two hours for exploration, the results seemed to justify another expedition, which was undertaken, in company with Prof. A. W. Evans, on May 30, 1906. On reaching the station noted above for *Cuphea*, we found a pool near by which was covered with a profusion of *Hottonia inflata* Ell. in flower. A little farther on in a small bog we found a few plants of *Epilobium strictum* Muhl., growing with a sedge, which later investigation showed to be *Carex brunnescens* (Pers.) Poir., and in cleared ground at the head of the pond, a quantity of *Hieracium floribundum* Wimm. &. Grab. a species which has only recently been reported from the state but seems to be spreading. After searching in vain for the *Arenaria* I climbed the cliff to the top of the mountain, while Prof. Evans searched for *Hepaticae* on the slopes. I was rewarded for the rather stiff climb by the discovery of *Carex eburnea* Boott, a species previously known from Connecticut only from the limestone region of Litchfield County and from the neighborhood of Southington. Later we found *Lycopodium annotinum* L., on the borders of a swamp a few hundred feet north of the pond, an extension of range southeasterly of some forty miles. Here were also *Cornus Canadensis* L. and *Clematis verticillaris* DC. After tracing the *Polymnia* some quarter of a mile northerly from the place where it was found in September, we left the locality.

In addition to the plants noted above a peculiar gooseberry was found on the first expedition, which, after comparison at New Haven and at the Gray Herbarium, was thought to be *Ribes lacustre* Poir., and was so reported at the winter meeting of the Connecticut Botanical Society. On collection of flowers and young fruit it proved to be a form of *R. oxyacanthoides* L. peculiar in its almost spineless but

densely weak-prickly or hispid semi-prostrate stems, which seldom use more than 2–3 dm. above the ground.

Oxford, Connecticut.

Polytrichum gracile Dicks. in Maine.— In one of the wooded swamps at Middle Dam, Rangeley Lakes, Maine, there was found in Sept., 1906, one small clump of Polytrichum with leaves resembling those of *Catharinea angustata*. Prof. J. Franklin Collins, to whom the moss was sent, determined it as *P. gracile* Dicks. According to him, it is not the typical form, but agrees with one of the variations noted in Dixon and Jameson's Handbook of British mosses. The leaf-margins are about three times wider than in the type, and the lamellae are only three cells high instead of four or five. Prof. Collins has not been able to learn of any previous collection of this species in Maine.— Elizabeth Marie Dunham.

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NOTES ON NEW ENGLAND HEPATICAE,—V.

Alexander W. Evans.

(Plate 73.)

(*Continued from p. 60.*)

6. Calypogeia sphagnicola (Arn. & Perss.) Warnst. & Loeske, Verhandl. Bot. Ver. Prov. Brandenburg **47**: 320. 1905. *Kantia sphagnicola* Arn. &. Perss. Rev. Bryol. **29**: 26. *f. 1–8.* 1902. *Cincinnulus Trichomanis*, var. *sphagnicola* Meylan, Bull. de l'Herb. Boissier II. **6**: 499. 1906. In tufts of *Dicranum Bergeri* growing in a bog; New Milford, Connecticut (*A. W. E.*). The present species was first described from Swedish specimens but has since been collected in Scotland, in Austria, in Switzerland, and apparently in northern Germany. The New England plants agree closely with the type material, and the writer's determination has been confirmed by Macvicar. *C. sphagnicola* is close to *C. Trichomanis* but differs from it in a number of respects and is apparently worthy of specific rank. Even when well developed it is a small species and is pale green in color, slightly tinged with yellow. The leaves are imbricated and spread from the axis at an angle of about 45 degrees, which is considerably less than in *C. Trichomanis*. They are distinctly convex, the apex being frequently revolute, and they are usually 0.85–1 mm. long and 0.6–0.7 mm. wide. The postical base is normally rounded and abruptly short-decurrent, and the apex varies from obtuse to rounded or slightly emarginate. The leaf-cells average about 40 × 27 μ and develop small but distinct trigones; these are usually triangular in outline with straight or concave sides but are sometimes

more nearly circular, the sides being convex. The orbicular or ovate-orbicular underleaves average about 0.35 mm. in length and give rise to a great abundance of long rhizoids. They are bifid to the middle or a little beyond with a blunt sinus and the divisions are erect or slightly divergent and obtusely pointed. In rare instances one of the divisions bears a blunt supplementary lobe on the outside. The inflorescence is described as autoicous. The small size of the plants, the angle at which the leaves spread, the distinct trigones, and the deeply bifid underleaves usually make it easy to distinguish the species from *C. Trichomanis.* Unfortunately etiolated stems are often developed in which the leaves are long-decurrent and the trigones scarcely apparent. Such stems might be the source of considerable confusion, if they were not always associated with normal stems in which the true characters of the species were well shown.

7. Calypogeia suecica (Arn. & Perss.) C. Müll. Frib. Beih. zum Bot. Centralbl. **17**: 224. 1904. *Kantia suecica* Arn. & Perss. Rev. Bryol. **29**: 29. *f. 1–6.* 1902. *Cincinnulus suecicus* C. Müll. Frib. Beih. zum Bot. Centralbl. **13**: 98. 1902. *Cincinnulus Trichomanis,* var. *suecicus* Meylan, Bull. de l'Herb. Boissier II. **6**: 499. 1906. On rotten logs. Mt. Katahdin, Maine (*Cowles Party, 33*).[1] Stafford, Connecticut (*G. E. Nichols*). Since the original publication of this species from Swedish specimens it has been reported from Scotland, France, Germany, Austria and Switzerland. As in the case of *C. sphagnicola,* however, this is the first record for North America. The New England specimens have been compared with a portion of the type material with which they agree closely. *C. suecica* seems to be confined to rotten logs and is often found in company with such species as *Cephalozia lunulaefolia, Riccardia latifrons* and *Lophozia porphyroleuca.* It bears a strong resemblance to *C. Trichomanis* but is considerably smaller, being of about the same size as *C. sphagnicola.* The leaves are convex and occasionally revolute at the apex; they spread obliquely from the axis at about the same angle as in *C. Trichomanis* and therefore more widely than in *C. sphagnicola.* The leaves are triangular-ovate in outline and their apices are very variable, being normally rounded but frequently truncate or bidentate, both teeth and sinus varying from acute to rounded. The leaf-cells are small, averaging about 30 μ in diameter, and in the outer part of the leaf are characterized by distinct trigones, triangular in outline with

[1] Harvey (Rhodora **5**: 51. 1903) has listed these specimens as *Kantia Trichomanis* from an earlier determination by the writer.

straight or slightly convex sides. The underleaves are relatively large and frequently imbricated, averaging about 0.45 mm. in length and from 0.45–0.6 mm. in width. They are broadly orbicular and bifid to the middle or beyond with an acute sinus and acute or obtuse lobes. Sometimes the lobes are entire but it is more usual for them to bear a blunt supplementary tooth on the outside, and occasionally a second tooth of this character is to be observed. The inflorescence seems to be constantly dioicous. In distinguishing the species from *C. Trichomanis* the small size, the variable leaves, the small leaf-cells with trigones, and the deeply bifid underleaves afford the most trustworthy differential characters. The peculiar habitat of the plant should also be kept in mind.

8. Calypogeia Sullivantii Aust. Hep. Bor.-Amer. *74b.* 1873. *Kantia Sullivantii* Underw. Bot. Gaz. **14**: 196. 1889. The type material of *C. Sullivantii* came from Alabama but the species was also known to Austin from New Jersey. It has since been recorded from Massachusetts, Rhode Island, and Connecticut and the writer has lately received specimens from North Carolina and Arkansas. It evidently replaces the European *C. arguta* in North America and is very different from the other species noted in the present paper. Since the published descriptions are incomplete, a fuller account of the species, with figures, may perhaps be of service.

The plants grow scattered or in very loose mats and vary in color from a pale yellowish green in exposed localities to a deeper green in the shade. The stems are prostrate and sparingly branched. They are somewhat flattened and show a distinction between the cortex, which is composed of a single layer of enlarged cells, and the median region, which is made up of a mass of smaller cells about four cells wide and three cells thick. The cortical cells are commonly arranged in ten longitudinal rows, four antical, four postical, and one lateral on each side (*f. 3*). The postical cells are a little larger than the antical, but the lateral cells surpass both in size, measuring from 45–70 μ in length and about 45 μ in width. They give the stem the appearance of being narrowly winged. The leaves are attached to these long cortical cells for about three fourths their width, the line of insertion curving at its apical end to the middle of the antical surface of the stem (*f. 4*). A similar stem-structure is found in *C. arguta* and also in the Hawaiian *C. bifurca* Aust.;[1] it bears a strong resemblance to the

[1] Proc. Acad. Nat. Sci. Phil. 1869: 223. See also C. M. Cooke, Jr., Trans. Conn. Acad. **12**: 26. *pl. 9, f. 1–10.* 1904.

structure of the midrib in *Metzgeria* and in the remarkable South American genus *Pteropsiella* as described and figured by Spruce.[1]

The leaves are usually small and rudimentary at the base of a stem or branch, then increase rapidly in size toward the middle and become smaller again toward the apex. They vary from distant to loosely imbricated and spread widely from the axis, sometimes at nearly a right angle. In the median region, where they are most normally developed, they are ovate to broadly ovate in outline, 0.75–1.2 mm. long, 0.6–0.85 mm. wide, and plane or nearly so. The postical margin is usually a little more curved than the antical and either meets the axis at a wide angle or is short-decurrent. The leaves gradually narrow out toward the apex, which is uniformly bidentate with sharp parallel teeth separated by an obtuse to lunulate sinus. The teeth are usually three or four cells long and two cells wide at the base, but these numbers are subject to some variation (*f. 5, 6*). The leaf-cells are large, averaging about $60 \times 40\ \mu$, but there is usually a sharp contrast between them and the lateral cortical cells, since the long axes of the latter extend in a different direction. The walls of the cells are either thin throughout or uniformly thickened and do not show distinct trigones. The free walls on both leaf-surfaces are characterized by being minutely verruculose, the walls in the other New England species being smooth throughout.

The underleaves are distant and minute, measuring about 0.2 mm. in length and 0.25 mm. in width. They are sometimes appressed to the axis, sometimes more or less spreading and sometimes completely reflexed and give rise to a large number of long rhizoids. They are rectangular or trapezoidal in outline and deeply bifid with a lunulate sinus, the divisions being more or less divergent and acute. Each division is tipped with a hyaline papilla and bears a small and sharp tooth, also tipped with a papilla, on the outside. The underleaves are fairly definite in structure; each division is usually two or three cells wide at the base and three or four cells long, and the lateral tooth, which arises directly from the broad base, is usually composed of a single cell (*f. 8*). In the basal and apical regions of the stem the structure of the underleaves becomes somewhat simpler. The inflorescence in *C. Sullivantii* is dioicous but the sexual branches afford no differential characters of importance, and the perigynium and sporophyte are still unknown.

[1] Hep. Amaz. et And. 390. *pl. 16.* 1885.

The flattened stem with its distinct cortical layer, the bidentate leaves, the large leaf-cells with verruculose cuticle, and the minute underleaves with their sharp and unidentate divisions afford a combination of characters which will at once distinguish *C. Sullivantii* from all other known New England species. These peculiarities, however, are all shared by *C. arguta*, which, although European, has been reported from greenhouses in Philadelphia and is perhaps to be expected in similar localities elsewhere. *C. arguta* is distinguished mainly by the longer and more divergent teeth of its leaves, separated by a broader sinus.

9. **Calypogeia tenuis** (Aust.) spec. nov. *C. Trichomanis*, var. *tenuis* Aust. Hep. Bor.-Amer. *74*. 1873. *Kantia Trichomanis*, var. *tenuis* Underw.; A. Gray, Manual, Ed. 6, 713. 1890. In bogs. Closter, New Jersey (*C. F. Austin*). Woodbury, Connecticut (*A. W. E.*). The Woodbury specimens are in a somewhat better condition than those distributed by Austin and may be designated the type.

Pale to bright green, growing scattered among Sphagna or forming loose tufts: stems varying from prostrate to ascending or erect, 0.15–0.25 mm. in diameter, cylindrical and composed of undifferentiated cells; vegetative branches few, mostly postical but occasionally lateral: leaves distant to loosely imbricated, slightly convex, spreading at an angle of about 60 degrees, arching partially across the axis, ovate, 0.9–1.2 mm. long, 0.7–0.85 mm. wide, normally rounded and short-decurrent at base but often gradually long-decurrent in poorly developed forms, margin entire or irregularly sinuate, apex rounded, obtuse or more or less bilobed (in very rare cases even trilobed), both lobes and sinus very variable; leaf-cells thin-walled throughout, averaging $40 \times 30\ \mu$ at the margin of the leaf and $50 \times 40\ \mu$ in median and basal regions, cuticle smooth: underleaves distant, ovate or broadly ovate, 0.45–0.6 mm. long, 0.35–0.5 mm. wide, bifid to the middle or beyond with an obtuse sinus, divisions erect, triangular to subulate, acute to rounded at the apex, mostly six to nine cells long and four to six cells broad at the base, rarely bearing a blunt or sharp supplementary tooth on the outside: inflorescence (so far as known) dioicous: ♂ inflorescence occupying a short branch or terminal on a somewhat longer microphyllous branch; bracts in three to six pairs, closely imbricated, deeply two- to four-lobed; bracteoles small, deeply bifid; antheridia single or in pairs: ♀ inflorescence not seen: gemmae oval, mostly bicellular, with a slightly thickened outer wall, borne in dense masses at the tips of microphyllous stems or branches.

Although the present species is close to *C. Trichomanis*, agreeing with it in several important respects, it can be at once distinguished by its smaller size and more delicate habit, by its variable leaves

showing a strong tendency to be bidentate or bilobed, and by its deeply bifid ovate underleaves. Most of these peculiarities will also separate it from *C. fissa* Raddi, the type of the genus, which is perhaps to be expected in southern New England. This species also has more or less bidentate leaves and deeply bifid underleaves, but the teeth of the leaves are usually sharp, and the underleaves are considerably broader than long.

C. tenuis is of about the same size as *C. sphagnicola* and grows in similar localities. Its more widely spreading leaves and its larger leaf-cells, destitute of trigones, will at once serve to separate it. From *C. suecica* it may be distinguished by its loose habit and larger, thin walled cells. Although *C. tenuis* does not agree with any of the recent European segregations from *C. Trichomanis*, its detection in Europe would not be surprising.

10. Calypogeia Trichomanis (L.) Corda. The range of the present species extends across northern Asia, Europe and North America. Throughout this wide territory it is abundant nearly everywhere and has already been reported from each of the New England states. In its most typical condition it is found on soil rich in humus, either on shaded banks or in the woods. Under these circumstances the plants are more robust than in any of the preceding species, the leaves often attaining a length of 2 mm. and a width of 1.5 mm. Such leaves are imbricated and ovate, spreading from the stem at an angle of about 60 degrees; they are either rounded or very obtuse at the apex and at the base are straight and slightly or not at all decurrent. The underleaves are orbicular and close together but rarely imbricated; they attain a maximum length of about 1 mm. and are bifid one fourth or less with rounded divisions and a shallow, usually rounded, sinus. At the base they are more or less decurrent and are attached by an arched line; supplementary lobes on the sides are wanting or very infrequent. The leaf-cells average about $50 \times 40\ \mu$ but vary considerably both in form and in size. Their walls are thin throughout or very slightly thickened and do not show distinct trigones.

When the species grows on sandy soil or in very wet places some of the characters which have just been described show themselves to be unstable. The leaves, for example, tend to become long-decurrent and sometimes show indications of apical teeth, while the underleaves tend to become smaller, more deeply bifid and with sharper divisions.

It is often a question whether these aberrant plants actually represent forms of *C. Trichomanis*, or whether they may not be worthy of specific recognition. The tendency at the present time, as shown by the publication of such species as *C. sphagnicola*, *C. suecica* and *C. tenuis*, is to adopt the latter view, and it is probable that further segregations from *C. Trichomanis* will be made in the near future.

11. SCAPANIA APICULATA Spruce, Ann. & Mag. Nat. Hist. II. **4**: 106. 1849. *Martinellia apiculata* Lindb.; Lindberg & Arnell, Kongl. Svenska Vetensk.-Akad. Handl. **23**[5]: 32. 1889. On log in river; Chocorua, New Hampshire, August, 1906 (*W. G. Farlow*). This rare species was originally collected by Spruce on the French side of the Pyrenees, and for many years no other localities were reported. At the present time, according to Müller,[1] it is known from Norway, Germany, Switzerland and Siberia, as well as from France. He also quotes a single North American station, North Elba, New York, where Peck[2] collected the plant less than ten years ago. Chocorua is therefore the second locality recorded for North America. The species was found, however, by Macoun, as long ago as 1881, at Manitoba House, Manitoba, although it is not mentioned in his Catalogue of Canadian Plants. *S. apiculata* is one of the few species of the genus which grow on rotten logs. It bears a certain resemblance to small forms of *S. umbrosa*, which sometimes grows in similar localities. In *S. apiculata*, however, the leaves are entire, and their antical lobes spread obliquely instead of being suberect. Both lobes are either acute or apiculate. The leaf-cells average about 18 μ in the middle of the postical lobe and are characterized by distinct and often conspicuous trigones. The cuticle is said to vary from smooth to minutely verruculose, but the latter condition prevails in American specimens. The perianth is entire at the mouth or very slightly crenulate from projecting cells. The species frequently reproduces by means of gemmae, which present a characteristic appearance. They occur in dense masses at the tips of leaves which are somewhat reduced in size but otherwise scarcely modified. The gemmae themselves are oval in form and unicellular, and their walls are deeply pigmented with brown or purple. They resemble the bicellular gemmae found in *Sphenolobus exsectus*, but this species may be at once distinguished by the smaller and often tooth-like antical

[1] Nova Acta Acad. Caes. Leop. Carol. **83**: 265. 1905.
[2] Bull. N. Y. State Mus. **6**: 178. 1899.

lobes of its leaves, and by its smaller leaf-cells with indistinct trigones. Apparently the nearest ally of *S. apiculata* in North America is *S. glaucocephala* (Tayl.) Aust., which has been reported from New England without definite stations. In this species the gemmae are usually unicellular and are very similar to those just described. They are found, however, on modified flagelliform shoots bearing small and distant leaves. The normal leaf-cells are of about the same size as in *S. apiculata*, but their trigones are minute and scarcely evident. On the gemmiparous branches the cells which give rise to the gemmae are much larger than the others and show strongly thickened walls, but even here there are no distinct trigones. *S. apiculata* should be looked for in other parts of New England, especially in mountainous regions.

12. Frullania Tamarisci (L.) Dumort. The relationship between the present species and *F. Asagrayana* Mont. is so close that it is very difficult to draw a line of demarcation separating them. In the writer's Revision of the North American Species of *Frullania*,[1] certain characters derived from the basal auricles of the underleaves and from the lobules of the leaves and bracts are emphasized as differential. In *F. Tamarisci*, for example, the auricles of the underleaves and the large stylus of the lobule are described as crispate, while the lobules of the bracts are said to bear clusters of fine cilia at the base instead of distinct segments. In *F. Asagrayana*, on the other hand, the auricles (even when present) and the styluses are said to be never crispate, while the basal segments of the bracteal lobules are described as being well developed. In a recent letter Mr. S. M. Macvicar, of Invermoidart, Scotland, has called attention to the fact that these differential characters are by no means constant. In support of his statement he has kindly communicated specimens of a Scotch form of *F. Tamarisci* in which the underleaves and the lobules of the ordinary leaves are essentially like those in *F. Asagrayana*, and in which the lobules of the bracts bear distinct basal segments. That this form belongs to *F. Tamarisci* and not to *F. Asagrayana* is shown by the sharply pointed leaf-lobes and by the more or less irregular arrangement of their ocelli, the lobes in *F. Asagrayana* being normally rounded at the apex and developing ocelli in a nerve-like row. Apparently these slight and relative differences are all that remain to distinguish the two species, and it becomes a question whether to

[1] Trans. Conn. Acad. **10**: 27. 1897.

consider *F. Asagrayana* distinct or simply one of the extremes of a very variable species, the other being the robust normal form of *F. Tamarisci*. The first course seems to be still justifiable on account of the fact that no European forms of *F. Tamarisci* are known which exactly correspond with any of the American forms of *F. Asagrayana*. *F. Tamarisci* is a comparatively rare species in North America, and the following are the only New England stations known to the writer: Prospect Harbor, Maine (*Mrs. Northrop*); Blackstone, Rhode Island (*J. L. Bennett*); Seymour, Connecticut (*A. W. E.*). It has also been reported from Massachusetts.

The following represent additions to local state floras, not included in the preceding notes: *Frullania Brittoniae*, Buckfield, Maine (*J. A. Allen*); *Lophozia excisa*, North Haven, Connecticut (*A. W. E*)[1].; *L. porphyroleuca*, Willoughby, Vermont (*Miss Lorenz*) and Stafford, Connecticut (*G. E. Nichols*); *Odontoschisma denudatum*, Buckfield, Maine (*J. A. Allen*); *Sphenolobus minutus*, Mount Mansfield, Vermont (*Miss Lorenz*). The Maine record for *Riccardia palmata* and Rhode Island records for *Grimaldia fragrans*, *Reboulia hemisphaerica*, *Riccardia sinuata*, and *Geocalyx graveolens*, marked in the writer's Preliminary List with the sign "—" may now be marked with the sign "+", the necessary specimens of these five species having been collected and communicated by J. F. Collins.

The census of New England Hepaticae now stands as follows:— Total number of species recorded, 141; number recorded from Maine, 88; from New Hampshire, 105; from Vermont, 83; from Massachusetts, 81; from Rhode Island, 64; from Connecticut, 102; common to all six states, 37.

Yale University.

Explanation of Plate 73.

Calypogeia Sullivantii Aust. Fig. 1, part of stem, postical view, × 25; Fig. 2, part of stem, antical view, × 25; Fig. 3, cross section of stem, × 55; Fig. 4, surface view of stem, showing parts of four leaf-bases, × 55; Figs. 5, 6, apices of leaves, × 55; Fig. 7, cells from middle of leaf, × 200; Fig. 8, underleaf, × 200. The figures were all drawn from specimens collected by the writer at Atsion, New Jersey, and distributed in Hep. Amer. *156* (as *Kantia Sullivantii*).

Calypogeia tenuis (Aust.) Evans. Fig. 9, part of stem, postical view, × 25; Fig. 10, part of stem, antical view, × 25; Fig. 11, slender stem, postical view, × 25; Fig. 12, cross section of stem, × 55; Fig. 13, cells from middle of leaf, × 200; Fig. 14, gemma, × 265. The figures were all drawn from the type specimen.

[1] These specimens have already been recorded and figured by Miss Haynes in the Bryologist **9**: 99. *pl. 9, f. 10–13.* 1906.

New Stations for Chamaecyparis on Long Island, New York.— Professor Fernald of the Gray Herbarium has called my attention to the fact that in Jelliffe's Flora of Long Island the only authority given for the occurrence of *Chamaecyparis thyoides* (L.) B. S. P., on the island is a report made in 1874 by E. S. Miller and H. W. Young who listed it as growing in Suffolk Co. In view of this it seems worth recording that there is a good colony of the tree growing within sight of the Long Island Railroad between the stations of Merrick and Bellmore, Nassau Co., and another just west of Amityville.— John Treadwell Nichols, American Museum of Natural History, New York.

An Occurrence of Catharinaea crispa in Maine.— I am pleased to announce the discovery of *Catharinaea crispa*, James in Maine, as I understand it has never before been reported from this state, or so far northeasterly as this. It was fertile, and was found in Camden, Maine, 44° N. lat. 69° W. long., in a pasture near the bank of a large brook, on knolls where six years ago a growth of alders had been cleared away. The altitude is about 200 feet. For its determination I am indebted to Mr. E. B. Chamberlain. Prof. J. Franklin Collins, in his list of New England plants, Rhodora **8**: 131, gives only Massachusetts as definitely possessing it.— Alice L. Crockett, Camden, Maine.

Noteworthy Plants of Salisbury, Connecticut.— The past season I have been able to add the following rare or unusual plants to the list of those growing about Salisbury, Connecticut.

Aspidium simulatum Davenp. In a black spruce swamp growing in sphagnum. Elevation 2000 ft. Quite abundant.

Pellaea gracilis Michx. A third colony of this rare fern on an exposed boulder in a dense pine wood.

Lycopodium annotinum L. In the same swamp with the *Aspidium simulatum*.

Potamogeton lucens Connecticutensis Robbins. Seems to be fairly abundant in one of the Twin Lakes.

Eleocharis olivacea Torr. One colony on the shore of a mountain lake at an elevation of 2000 ft.

Habenaria orbiculata (Pursh) Torr. In rich woods at Lime Rock. Not at all common.

Claytonia Virginica L. A number of large colonies in a hardwood swamp.

Polanisia trachysperma T. & G. A waif from the west but growing abundantly on the gravelly banks of the Salmonkill at Lime Rock.

Lythrum alatum Pursh. A large colony on a dry hillside not far from Twin Lakes.

Vaccinium Canadense Richards. Found by Mr. Weatherby of East Hartford in one of the mountain swamps.

Polemonium Van Bruntiae Britton. Three vigorous plants in a swamp bordering a lake. Seems to be native.

Hydrophyllum Virginicum L. In thicket along set-backs from the Housatonic river.

Scutellaria parvula Michx. Wet meadow near Twin Lakes.— ORRA PARKER PHELPS, Chapinville, Connecticut.

ARCEUTHOBIUM PUSILLUM AT MT. DESERT.— Since the discovery of the Dwarf Mistletoe in abundance on Isle au Haut in East Penobscot Bay I have seen no reason why it should not occur on Mt. Desert as well, and have, therefore, from time to time made careful search for it in the endeavor to extend its range eastward along the coast. I met with no success in my examination of its most common host-plant, the Swamp Spruce (*Picea nigra* Link). Witches' brooms, to be sure, were often met with, but all appeared due to some other cause. I, therefore, began to think that the Island was free from this destructive but interesting plant. In August, 1906, however, just back of the precipitous cliff of Great Head on Frenchmans Bay a thriving colony of Arceuthobium was found at last. At the time it was unfortunately impossible to make careful observations of the extent of this colony, but judging from the general appearance of the spruces it had been long established. The host-plant here proved, in every case observed, to be the White Spruce (*Picea alba* Link), the most characteristic spruce of the rocky shores of the region.

The facts observed in regard to the dwarf mistletoe and this host were practically the same as those mentioned by Dr. von Schrenk as occurring under the same conditions on Monhegan Island and the neighboring mainland, published in RHODORA (ii. 2, 1900), so any repetition is unnecessary. One observation, however, made from these Mt. Desert specimens I speak of here because, so far as I know,

there is no prior record of it. The influence of the parasite on its host is well marked in various ways, as noted in the article above referred to, and is of a decidedly stimulating character as is shown by greatly increased growth of branchlets and leaves. In my specimens a further effect was shown by a decided change in the odor of the spruce leaves where this stimulated growth took place, or in other words where the mistletoe was found. When I first noticed a sweetish balsamic odor, far more resembling that of the Fir Balsam than that of the White Spruce, I felt that I had mistaken the identity of the host-plant. I found, however, that I had made no mistake, but that these White Spruce leaves no longer retained in any marked degree the disagreeable odor which has given the species the name of Cat, or Skunk Spruce. This modification of odor thus produced in the host by the parasite is very agreeable, and so marked as to be decidedly noticeable. This fact I verified by submitting specimens to a number of persons, all of whom reached this same conclusion. Some of them could not be convinced that the leaves from the infected and the uninfected trees were not those of different species. It may be added that some species of Arceuthobium have a decidedly balsamic odor, but this was not noticed in my specimens of *A. pusillum*.— Edward L. Rand, Boston.

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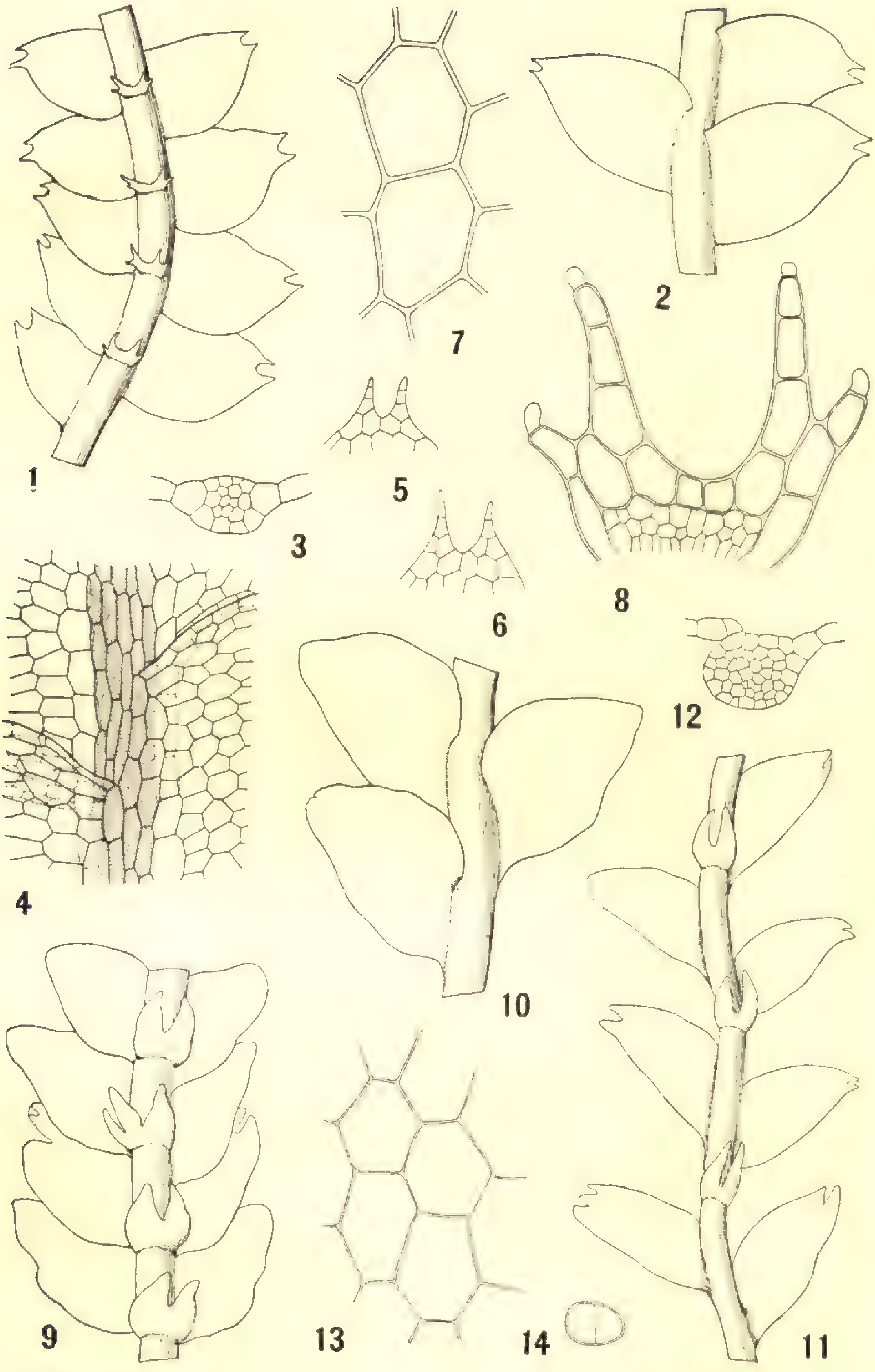

A. W. Evans del.

1–8 Calypogeia Sullivantii Aust.
9–14 Calypogeia tenuis (Aust.) Evans.

Rhodora

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THE BASIS OF NOMENCLATURE FOR ALGAE.

F. S. Collins.

Readers of the article "On the Vienna Rules of Botanical Nomenclature" in the March Rhodora will remember that Art. 9 reads "The rules and recommendations of botanical nomenclature apply to all classes of the plant kingdom, reserving special arrangements for fossil plants and non-vascular plants"; and that a footnote states that these special arrangements have been reserved for the Congress of 1910. The questions involved in regard to cryptogams are many and difficult to answer, and when we consider the long and careful work that was necessary to reach a conclusion in regard to the vascular plants, the time before the next Congress is none too long for their consideration. "Botanical nomenclature begins with the Species Plantarum of Linnaeus," says Art. 19; but if one considers the quite insignificant space given to the cellular cryptogams in this work, it might possibly be called a "point" for starting, certainly not a "base" for anything. The writer cannot claim any familiarity with the subject except as regards the algae, but would like to call attention to some features of their case.

While the number of known species of flowering plants has increased almost in geometrical ratio, the idea of a species, on the whole, remains about the same. Some species have been found to be aggregates; with rapidly increasing numbers of species more attention has to be given to smaller details, but in the great majority of cases the characters by which species are differentiated can be seen by the naked eye, or with a pocket lens. As regards algae, not one species in a hundred can be described so that it could be recognized without the use of the microscope, usually requiring quite high powers. Of course none of these

could have been recognized in Linnaeus's day, nor for a long time afterwards. The system of classification adopted by Linnaeus for flowering plants remained in general use until superseded by a natural system, which in its general outlines and often in considerable detail is accepted at present. But all through the nineteenth century system after system was proposed for the algae, each practically beginning anew, the position of genera changing with kaleidoscopic rapidity. It is sometimes really pathetic to see with what conscientious care a system was developed on what we now know to have been scanty material, imperfect data, and misinterpreted observations. Occasionally we find a piece of work in some limited field of which the records have been supplemented rather than superseded by later observations; thus the insight of Vaucher's Histoire des Conferves, that celebrated its centenary four years ago, is little short of marvellous, when we consider the scanty appliances then available; Nägeli's Gattungen einzelliger Algen of 1848 must be referred to to-day by everyone studying the unicellular algae; but Nägeli's system, like the systems of Kützing and the others, was hardly more permanent than last year's snows. Back of the time of C. Agardh, in the earlier part of the last century, practically no types are to be found; and though in the Agardh herbarium, continued by the son, J. G. Agardh, we have a most valuable collection of original specimens, we find in many cases that more than one species, as we now know them, was included under one name; it was impossible to distinguish them at that day, and of course the diagnosis, giving only the characters then discernible, gives us little help as to which species should bear the name. Evidently the basis that is suitable for the nomenclature of the *Rosaceae* is not suitable for the nomenclature of the *Chlorophyceae*.

But is it possible to fix any one satisfactory basis for algae in general? The more we look at it, the less likely it seems. The larger algae, those included in the genus *Fucus*, were fairly well known to the older authors, so that nearly all of the species in Turner's Icones Fucorum, 1808–1819, remain valid to-day; but this is by no means the case with the species of Dillwyn's British Confervae of 1809. To ignore Turner's species in the Icones would certainly be unwise; to identify species of *Microspora* or *Oedogonium* by Dillwyn would be very difficult. Though the idea of different starting points for different families of algae may seem at first undesirable, it may be the best solution of the problem; a definite proposition to that

effect, the first proposition of the kind as far as known to the writer, has been made by Prof. O. Nordstedt.[1] As Nordstedt is the highest authority on the desmids, was a member of the Congress of Vienna, and was appointed on the committee to take charge of the preliminary work on non-vascular plants for the Congress of 1910, his opinions should carry much weight. He considers in detail all the genera and many of the species of desmids, proposed in the first half of the last century, a chaotic assemblage. While some authors made contributions of merit, there is no one work that can be considered as at all complete to its time until we come to Ralfs, who in 1848 published The British Desmidieae; this work gives detailed descriptions and excellent figures of all the British forms, and has as an "Appendix," a list of all other known species, a large part of them also with figures and descriptions. With few exceptions all the literature of the desmids up to 1848 was gone over by Ralfs, and references noted; the few papers to which Ralfs does not refer have been analyzed by Nordstedt, and while they add a few synonyms to Ralfs's species very little other change would have been necessary had Ralfs used them. There are a few genera in Ralfs's work which might have to give place to older names if we could be certain where we are now doubtful, but as after careful study of the older authors the uncertainty remains and is likely to continue, Nordstedt considers that the wisest plan will be to adopt for the desmids the rule "The nomenclature begins with the British Desmidieae by Ralfs in 1848." As a second rule he provides that all names used by Ralfs in Brit. Desm. as of earlier authors, should be so quoted, but only as so attributed by Ralfs; for instance *Euastrum oblongum* Grev. sec. Ralfs, Brit. Desm.

That this plan will simplify the nomenclature of the desmids is unquestionable, and that it will cause any serious inconvenience is unlikely. That Ralfs's monograph contains a few genera no longer classed as desmids can occasion no trouble, nor the fact that some of his genera have since been divided; that is merely what has always happened with increasing knowledge and discoveries of new forms. While in some cases Ralfs may have been misled by a faulty or hazy description by some older author, the chance of our now correcting this error is too small to outweigh the real gain of accepting Ralfs's definite description and clear figure, and working from them.

[1] Algological Notes 1–4. 1. The starting point of the nomenclature of Desmids. Botaniska Notiser, 1906, p. 97.

At the close of his paper Nordstedt mentions three monographs which may be used for bases in their respective sections; for practical work all three are now the standards, but to those who are worshipers of priority in itself, rather than as far as it may be the most useful means to an end, it will be rather a shock to find that these monographs date from 1888, 1893 and 1900 respectively: Gomont, Monographie des Oscillariées, 1893, and Bornet et Flahault, Revision des Nostocacées hétérocystées contenues dans les principaux herbiers de France, 1886–1888, have brought order where disorder reigned before; but as Nordstedt himself notes, they seldom recognize any species of which the authors have not examined authentic specimens; following each genus is a list of species inquirendae. Hirn, Monographie und Iconographie der Oedogoniaceen, 1900, is a more complete work, covering practically all known species, with full illustrations. It should be added that in the case of the heterocysted nostocs, Bornet and Flahault have since 1888, as a consequence of the examination of original specimens before unseen, published a paper changing in some few instances the names used in the Revision. What the status of these later names would be in case of the Revision being accepted as the beginning of nomenclature might be an interesting question.

In conclusion; the fact that Nordstedt recommends Ralfs as the starting point for the nomenclature of desmids is in itself a strong argument in favor of the plan, and a careful reading of his paper will prove quite convincing, it would seem, to any one who had not in some way prejudged the matter. It is likely that in regard to the other groups Nordstedt's suggestions, which are put forward as propositions only and without evidence or argument, may meet with more opposition; if so, however, it is for their opponents to propose something better.

Malden, Massachusetts.

REPORTS ON THE FLORA OF THE BOSTON DISTRICT,—I.

Over a year ago the New England Botanical Club decided to collect information in regard to the plants growing within 25 miles of Boston. This district was afterward extended, so that it runs northward to the New Hampshire line; west to include Dunstable, Groton, and Ayer; then southward along the Worcester county line, including Southboro, to Bellingham, on the Rhode Island boundary; thence eastward to the coast at Duxbury. The district thus formed is a good geographical unit, bounded by the New Hampshire line, the hill country of central Massachusetts, and the level sand-plain and morainal territory of southern Bristol and Plymouth counties. It therefore seems that it should possess a definite flora of its own, distinct in many ways from regions to the north, west and south.

The committee in charge has gathered a large amount of data in regard to the ferns of this district, which has been condensed into the present form for publication. This list is still regarded as a preliminary one, and any additions or corrections will be welcomed. There is especial lack of information in regard to the outlying towns of the region, in the south and west portions.

Card-records have been received regarding the ferns of this district from the Gray Herbarium, the Ames Botanical Laboratory, and the herbaria of Tufts College, the New England Botanical Club, the Boston Society of Natural History, the Appalachian Club, and the Bridgewater State Normal School. The following individual collectors have also furnished cards recording the ferns in their collections: Dr. C. A. Cheever, Hon. J. R. Churchill, J. A. Cushman, Walter Deane, Raynal Dodge, A. A. Eaton, F. G. Floyd, T. O. Fuller, C. H. Knowlton, A. H. Moore, C. H. Morss, A. S. Pease, George O. Tilton, R. A. Ware and E. F. Williams.

Wherever unusual ferns have been reported, the specimens themselves have been examined. Special examination has been made of the ferns in the Gray Herbarium, the Davenport collection of the Massachusetts Horticultural Society, and the herbaria of the New England Botanical Club and the Ames Botanical Laboratory. The Committee wishes to express its indebtedness to Dr. B. L. Robinson of the Gray Herbarium for advice and assistance in preparing this report.

POLYPODIACEAE.

POLYPODIUM.

P. vulgare L. Dry rocks and ledges, common.

PHEGOPTERIS.

P. polypodioides (L.) Fée. Damp rich woods; occasional, especially northward.

P. hexagonoptera (Michx.) Fée. Rich open woods, not common. All reports are from the central part of our territory.

P. Dryopteris (L.) Fée. Rich especially coniferous woods; occasional in Essex County, but rare elsewhere; not reported south of Needham.

ADIANTUM.

A. pedatum L. Rich deciduous woods; generally distributed, but only locally abundant.

PTERIS.

P. aquilina L. Dry open woods and uplands, common.

WOODWARDIA.

W. virginica (L.) Sm. Wet woods and peat-bogs, sometimes in water; frequent.

W. areolata (L.) Moore. (*W. angustifolia* Sm.) Swamps and wet woods; frequent within ten miles of tide-water, the stations often extensive.

ASPLENIUM.

A. Trichomanes L. Dry ledges; frequent, but never abundant in our range.

A. platyneuron (L.) Oakes. (*A. ebeneum* Ait.) Rocky soil and ledges throughout.

Var. **serratum** (E. S. Miller) BSP. One specimen, collected in Malden by Mr. George E. Davenport in 1872 and identified by Dr. Asa Gray, is now in the Gray Herbarium; and another, from Melrose, is in the Davenport Collection.

A. acrostichoides Sw. (*A. thelypteroides* Michx.) Rich woods; occasional in the northern towns, less frequent southward.

A. Filix-femina (L.) Bernh. Usually in damp woods and shaded places, though occasionally in drier situations; common and varying much with the conditions of soil, moisture, and shade. Var. **angustum** (Willd.) D. C. Eaton. Woods, occasional.

CAMPTOSORUS.

C. rhizophyllus (L.) Link. Granite ledges, Needham, where observed as early as 1877; formerly also on Doublet Hill, Weston.

POLYSTICHUM.

P. acrostichoides (Michx.) Schott. (*Aspidium acrostichoides* Sw.) Rocky woods, distributed here and there, but not very common. Var. **Schweinitzii** (Beck) Small. (Var. *incisum* Gray.) Amesbury (*J. W. Huntington*); Andover (*A. S. Pease*); Blue Hills (*E. F. Williams*).

ASPIDIUM.

A. Thelypteris (L.) Sw. Swamps, common everywhere.
Forma **Pufferae** (A. A. Eaton) B. L. Robinson in herb. *Nephrodium Thelypteris*, forma *Pufferae* A. A. Eaton. Border of meadows, Sudbury (*Mrs. J. J. Puffer*). See Eaton, Fern Bull. x, 78.

A. simulatum Davenp. Swampy woods; locally abundant; often associated with the preceding and with *Woodwardia areolata*. See Davenp. Bot. Gaz. xix. 494, 495.

A. noveboracense (L.) Sw. Low open woods, common.

A. marginale (L.) Sw. Rocky woods, common throughout. Var. ELEGANS J. Robinson (Bull. Essex Inst. vii. 51) is a luxuriant form with the pinnules more deeply crenate-toothed. This form not very sharply distinguishable from the type has been found at Ipswich (*Oakes*), Swampscott (*J. Robinson*), and Milton (*F. G. Floyd*).

A. Boottii Tuckerm. Low woods, frequent.

A. cristatum (L.) Sw. Open and wooded swamps; frequent: reported as abundant in Brockton, Easton, and in northern Essex County. Var. **Clintonianum** D. C. Eaton. Wooded swamps, occasional; not reported from open land. Not so extreme as the more northern and western specimens.

A. cristatum × marginale Davenp. Where swamps meet the rocky woods, rare. First described by Mr. Davenport from northern Essex County; Boxford, Merrimac, Salisbury, Medford, Byfield, Brockton; see Davenp. Bot. Gaz. xix. 494, 495.

A. spinulosum (O. F. Müller) Sw. Low open woods, frequent.

Var. **intermedium** (Muhl.) D. C. Eaton. Rich woods, frequent.

Var. **dilatatum** (Hoffm.) Hook. Swampy woods, fairly plentiful at Brockton (A. A. Eaton).

Forma **anadenium** B. L. Robinson.[1] This form, characterized by a glandless or essentially glandless indusium, includes the greater part of what has heretofore passed as var. *dilatatum* in America. It may be distinguished from the typical *A. spinulosum* by the narrower firmer and darker brown scales of the stipes and from var. *intermedium* by its broader ovate fronds and glandless indusium. In our region it is relatively rare and never quite so characteristic as in mountain specimens. Reports indicate that it has been found in Chelsea, Dedham, Manchester, and Woburn.

Var. **concordianum** (Davenp.) Eastman. Rich swampy woodland, Concord (*Purdie & Brewster, Davenport & Purdie*). See Rhodora, vi. 31–33.

CYSTOPTERIS.

C. fragilis (L.) Bernh. Moist or wet rocks and ledges in shade; not common, especially southward.

[1] Concerning this form Dr. Robinson makes the following statement: "*Aspidium spinulosum*, var. *dilatatum* (Hoffm.) Hook., as it occurs in Europe, regularly exhibits a glandular indusium, a fact substantiated by specimens and by the statements of several critical and reliable authors, such as Moore, Milde, Christ, and others. This European form must be regarded as the typical state of the variety. Until recently it has been almost unknown in America. To it seems to belong, however, the plant not long since described as *Nephrodium spinulosum*, var. *fructuosum* Gilbert, and study of a considerable suite of American specimens referred to Var. *dilatatum* shows that the indusium is occasionally glanduliferous as in the European plant. Nevertheless, as Prof. D. C. Eaton long ago remarked the indusium in the American Var. *dilatatum* is habitually glandless. This glandless form, which is readily recognizable with a good lens, seems never to have had a distinctive name and may therefore be called A. spinulosum, var. dilatatum, forma **anadenium,** n. f. indusio glandulis fere vel omnino destituto.— As an appropriate type-specimen for this new form I would mention a plant collected in deciduous woods, alt. 760 m., 14 August, 1895, on Barren Mt., Elliottsville Piscataquis County, Maine, by M. L. Fernald, no. 426 (type in hb. Gray; cotypes in several public and private herbaria). Forma *anadenium* is widely distributed in Atlantic North America, chiefly in mountainous regions."

WOODSIA.

W. ilvensis (L.) R. Br. Exposed dry ledges, occasional.

W. obtusa (Spreng.) Torr. Shaded ledges; scattered stations throughout.

DICKSONIA.

D. punctilobula (Michx.) Gray. (*D. pilosiuscula* Willd.) Moist soil in open places and light shade; common.

ONOCLEA.

O. sensibilis L. Damp woods and meadows, abundant.

O. Struthiopteris (L.) Hoffm. Moist soil, usually in shade; rare; not reported south of Boston.

LYGODIUM.

L. palmatum (Bernh.) Sw. Low thickets, rare. Carlisle, Concord, Dover (1883, 1884), Saugus (1885), Newton; the last three stations probably extinct.

OSMUNDA.

O. regalis L. Swamps, wet woods, and lake shores; common.

O. Claytoniana L. Somewhat less common than the following species.

O. cinnamomea L. Swamps and low woods, common. The formal var. FRONDOSA Gray is occasionally found with the typical form.

OPHIOGLOSSACEAE.

OPHIOGLOSSUM.

O. vulgatum L. Moist fields and pastures, local.

BOTRYCHIUM.

B. simplex E. Hitchcock. Low woods; Amesbury, Byfield, Easton, Salisbury, W. Newbury.

B. lanceolatum (Gmel.) Ångstr., var. **angustisegmentum** Pease & Moore. Low woods, rare; stations occasionally large. See Rhodora, viii. 229.

B. ramosum (Roth) Aschers. (*B. matricariaefolium* A. Br.) Low woods; Amesbury, Dedham, Natick, Needham, Salisbury, W. Newbury.

B. obliquum Muhl. Old fields and pastures; occasional, and locally abundant.

Var. **elongatum** Gilbert & Haberer. Georgetown (*Mrs. C. S. N. Horner*, specimen in hb. N. E. Bot. Club, also in the Davenport Collection).

Var. **dissectum** (Spreng.) Clute. Old fields and pastures, frequent.

B. ternatum (Thunb.) Sw., var. **intermedium** D. C. Eaton. Old fields, pastures, and rarely in woods; frequent.

B. virginianum (L.) Sw. Rich woods, occasional.

A. K. Harrison, (Chairman)
F. F. Forbes,
C. H. Knowlton,
R. A. Ware.
} *Committee on local flora*

PRELIMINARY LISTS OF NEW ENGLAND PLANTS,—XX.

SPARGANIACEAE.[1]

M. L. Fernald and A. J. Eames.

[The sign + indicates that an herbarium specimen has been seen; the sign — that a reliable printed record has been found.]

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.
Sparganium americanum Nutt.	+	—	+	+	+	+
" " var. androcladum (Engelm.) Fernald & Eames	+	+	+	+	+	+
" angustifolium Michx.	+	+	+	+		+
" diversifolium Graebner	+	+	+	+		+
" " var. acaule (Beeby) Fernald & Eames	+	+	+			+
" eurycarpum Engelm.	+	—	+	+	+	+
" fluctuans (Morong) Robinson	+	+	+	+		+
" lucidum Fernald & Eames				+		
" minimum Fries	+		+	+		+
" simplex Hudson	+		+			

[1] Printed in Rhodora as supplementary material.

Notes upon the above List.

Sparganium fluctuans (Morong) Robinson. For detailed discussion see Rhodora, vii. 60 (1905).

Sparganium simplex Hudson has been reported from all the New England states, but it is very doubtful if it occurs as far south as Massachusetts. Most of the plants of southern New England so reported have proved to be either *S. americanum, S. diversifolium* or its var. *acaule*, or *S. lucidum*. The New England plants which have been passing as *S. simplex* may be distinguished as follows.

Sparganium simplex and its New England Allies.

* Pistillate heads or branches of the inflorescence strictly axillary.

+- Mature fruits dull: stigma 1–2 mm. long.

S. americanum Nutt. Stoutish, 3–7 dm. high: leaves deep green, dorsally carinate, 6–12 mm. broad: bracts divaricate or arcuate-ascending, the lowest 0.8–2.2 dm. long: inflorescence simple: pistillate heads 2 to 5, all axillary, sessile or nearly so, in fruit 1.8–2.6 cm. in diameter: tepals with dilated and rounded erose summits; their bases closely investing the stipe of the carpel: mature fruits brownish, fusiform; the narrowly ellipsoid or subcylindric body 5–6 mm. long, 2–3 mm. thick; the beak (including the stigma) 2.5–4 mm. long, about equalling the slender stipe.— Gen. ii. 203 (1818). *S. simplex*, var. *Nuttallii* Engelm. in Gray, Man., ed. 5, 481 (1867); Morong, Bull. Torr. Cl. xv. 79 (1888). *S. simplex* of many Am. auth., not Hudson. *S. angustifolium* Graebner in Engler., Pflanzenr. iv. no. 10, 16, in part (1900), not Michx. *S. Nuttallii* Engelm. according to Graebner, l. c. (1900). *S. americanum*, var. *Nuttallii* Graebner, l. c. (1900). *S. simplex*, var. *americanum* Farwell, Ann. Rep. Mich. Acad. Sci., vi. 202 (1904).— Bogs and muddy shores, New Brunswick to Iowa and Virginia; also in eastern Asia.

Var. **androcladum** (Engelm.), n. comb. Inflorescence bearing from its lower axils 1 to 3 weak branches: leaves often broader (rarely 2 cm. broad): lowest bract 1.5–5 dm. long.— *S. simplex*, var. *androcladum* Engelm. in Gray, Man., ed. 5, 481 (1867). *S. ramosum* Chapm. Fl. 443 (1860), not Huds. *S. androcladum* Morong, Bull. Torr. Cl. xv. 78 (1888); Graebner in Engler, Pflanzenr, iv. no. 10, 15 (1900).— Similar places, more common, Newfoundland to Minnesota, south to Florida and Missouri.

+- +- Mature fruits lustrous: stigma 2.5–4 mm. long.

S. lucidum, n. sp. Planta 7.5–9 dm. alta; foliis 5–12 mm. latis, erectis, firmis et haud pellucidis, valde carinatis, inflorescentiam sim-

plicem vel ramosam multo supereminentibus, capitibus vel ramis plane axillaribus; bracteis patente ascendentibus, infima 2.5–4 dm. longa; capitibus femineis sessilibus vel infimis pedunculatis, ad maturitatem circiter 3 cm. diametro; tepalis ad stipitem affixis, ligulatis, apice dilatatis et rotundis, subintegris vel erosis; costa media prominente et in apice suo incrassata; fructubus maturis lucidis, olivaceo-brunneis, breviter stipitatis, corpore subterete, 5–6 mm. longo, 2–3 mm. crasso; stylo subulato-filiforme, 5–7 mm. longo, parte lineare stigmatica adunca, 2.5–4 mm. longa.

Plant 7.5–9 dm. high: leaves 5–12 mm. broad, erect, firm and opaque, strongly carinate, much overtopping the simple or forking inflorescence: the heads or branches strictly axillary: bracts spreading-ascending, the lowest 2.5–4 dm. long: pistillate heads sessile, or the lowest peduncled, in fruit about 3 cm. in diameter: tepals attached to the stipe, ligulate, with dilated and rounded sub-entire or erose tips; the midrib prominent and thickened at its apex: mature fruits lustrous, olive-brown, short-stipitate; the subterete body 5–6 mm. long, 2–3 mm. thick: style subulate-filiform, 5–7 mm. long; the linear stigmatic portion hooked, 2.5–4 mm. long.— Massachusetts, small pond, Medford, July 29, 1860 (*Wm. Boott*); muddy shore of Half-way Pond, Barnstable, August 23, 1888 (*W. Deane*): Pennsylvania, ditches, Philadelphia, September, 1876 (*I. C. Martindale*): Illinois, without station (*S. B. Mead*): Missouri, Springfield, September 1, 1893 (*J. W. Blankinship* in hb. Deane).

* * One or more of the pistillate heads supra-axillary.

+— Erect plants of shores and swamps: leaf-blades of uniform texture, somewhat translucent and reticulated under a lens.

S. diversifolium Graebner. Erect, stoutish, 3–6 dm. high: leaves delicate, cellular-reticulated on both sides, 4–9 mm. wide, with a broad scarious margin toward the base: bracts strongly ascending, the lowest 2–5 dm. long: inflorescence mostly simple, rarely with 1 or 2 weak branches: pistillate heads 2 to 4, chiefly sessile, the lower remote and supra-axillary, in fruit 2–2.5 cm. in diameter.— Graebner in Schrift. naturf. Ges. Danzig, N. F., ix. (1895) 335, t. 8, fig. 1, and in Engler, Pflanzenr, iv. no. 10, 21, fig. 4 F. (1900). *S. simplex* in great part of Am. auth., not Hudson.— Eastern Quebec to South Dakota, Connecticut and Illinois and probably southward; also in Europe. Passing to

Var. **acaule** (Beeby), n. comb. Dwarf, 1–3 dm. high: leaves and bracts comparatively narrow; the lowest strongly ascending bract 1–3 dm. long: pistillate heads 1.5–2 cm. in diameter, usually crowded. — *S. simplex*, var. *acaule* Beeby in Macoun, Cat. Can. Pl. ii. 367 (1890). *S. diversifolium*, proles *nanum* Graebner in Engler, Pflanzenr. iv. no. 10, 21 (1900). *S. nanum* Fries according to Graebner, l. c. (1900).— Newfoundland to Iowa and West Virginia.

+ + Strictly aquatic: leaf-blades reticulated beneath, opaque above.

++ Fruits rather abruptly slender-beaked: leaf-blades 1.5–4 mm. broad: stigma rarely over 1.2 mm. long.

S. ANGUSTIFOLIUM Michx. Slender aquatic: stems 3–12 dm. long: leaves exceedingly long and narrow, opaque: bracts comparatively short, slightly dilated at base, the lowest 0.5–3 dm. long: inflorescence simple, at the surface of the water: pistillate heads 1 to 3, sessile or peduncled (the lowest peduncle rarely 9 cm. long), in fruit 1.3–2 cm. in diameter: fruits 1.5–2 mm. thick, drab, with reddish-brown bases.— Fl. ii. 189 (1803); Graebner in Engler, Pflanzenr. iv. no. 10, 16, in part (1900). *S. simplex*, var. *angustifolium* Engelm. in Gray, Man., ed. 5, 481, (1867). *S. affine* Macoun, Cat. Can. Pl. ii. 71 (1888), perhaps also of Schnitzlein, Nat. Pfl. Typh. 27 (1845).— Ponds and slow streams, Newfoundland to Alaska, south, especially among the mountains, to Connecticut, New York, Colorado and California; ascending in alpine ponds to an altitude of 1140 m. on Table-top Mountain, Gaspé, and to 3500 m. in Colorado. Perhaps also in Eurasia (*S. affine* Schnitzlein).

++ ++ Fruits gradually acuminate: leaf-blades 4–9 mm. broad: stigma 1.5–2 mm. long.

S. SIMPLEX Hudson. Coarser, and in our region strictly aquatic: stems 3–10 dm. long: bracts somewhat dilated at base, the lowest 1–4 dm. long: inflorescence usually simple, elongated: pistillate heads 2 to 4, mostly supra-axillary, the lowermost long-peduncled, in fruit 2–2.5 cm. in diameter: fruit 1.5–2.5 mm. thick.— Fl. Angl. ed. 2, 401 (1778); Am. auth. in small part only; Graebner in Engler, Pflanzenr. iv. no. 10, 16 (1900).— Newfoundland to British Columbia, south to Maine, northern Vermont, Lake Superior region, Colorado, Utah, and California; also Eurasia.

Var. MULTIPEDUNCULATUM Morong. Heads aggregated, mostly pedunculate, subcorymbose.— Bull. Torr. Cl. xv. 79 (1888); Graebner in Engler, Pflanzenr. iv. no. 10, 17 (1900). *S. multipedunculatum* Rydberg, Bull. Torr. Cl. xxxii. 598 (1905).— From the Mackenzie River to Colorado and California; to be expected in northern New England and adjacent Canada.

Suggestions for Special Observations.

Sparganium angustifolium Michx. should be sought in the ponds and lakes of northwestern Rhode Island.

S. diversifolium Graebner may be sought in northwestern Rhode Island, and its var. *acaule* should be looked for there and in central and western Massachusetts.

S. fluctuans (Morong) Robinson may be expected in the larger ponds and lakes of northwestern Rhode Island.

S. lucidum Fernald & Eames, as yet known only from eastern Massachusetts, Pennsylvania, Illinois and Missouri, is probably in Rhode Island and Connecticut.

S. minimum Fries may be confidently sought in clear cold streams of northern New Hampshire.

S. simplex Huds. is apparently rare in northern and central Maine and northern Vermont, but it should be sought in all the larger lakes of northern New England.

Gray Herbarium.

CAUSES OF VARIATION IN COLOR IN SOME RED ALGAE.

William A. Terry.

For many years past I have noticed a marked difference in color in specimens of red algae from different localities; this is specially noticeable in *Dasya elegans* (Mart.) Ag.; plants from South Beach, a mile or more east of the entrance to New Haven harbor, always drying a sepia brown, while those from below Woodmont, some miles west, dry a dark purple, and those from Fort Hale, inside the harbor, show a bright crimson pink color. These differences are constant, and have shown themselves so for many years. My specimens are taken, when possible, directly from the rocks on which they grow; they are generally procured by wading at lowest tide, but sometimes from a boat by means of a sharp-edged scraper with a long handle. Such specimens are much deeper in color than those from shallow water. When broken from their holdfasts they change rapidly in color, in a few hours showing a decided tinge of brown. All these fine red seaweeds, if mounted in salt water, lose their characteristic color from the concentration of the salt, and become more or less black. To obviate this as much as possible, I lay out and cleanse the plant in a dish of salt water, then transfer on the cardboard to a mounting board in fresh water, rapidly place and lift out of the water, drain slightly and place in driers which are changed frequently until dry. In this

way much of the original color remains in some species; others obstinately persist in turning black when drying. The different behavior of plants apparently quite similar led me to make some experiments last November, which gave me new light on the question. I found most beautiful plants of the delicate Callithamnion of a most brilliant rosy color growing in deep water on the reef at Woodmont, and was much disappointed to find them losing their color in drying. I had used sometimes the city water and sometimes water from the shallow wells of the region in mounting, and I found a slight difference in favor of the city water; I then experimented with rain water, with marked success. It was evident that the mineral dissolved in the ordinary water was sufficient to destroy the color in drying.

The rocks on which the seaweeds grow at South Beach are red granite. The beach contains a large amount of red sand, sufficiently heavy to be easily separated from the quartz sand by washing. A superficial examination seems to show zircon and garnet, and a mineralogist to whom I sent a sample said that it contained about two per cent of monazite. The rocks on which the red Dasya grows at Fort Hale are trap. The purple Dasya at Woodmont grows on a curious shale or slate, that suggests the vicinity of magnesian limestone. It is penetrated by fresh water springs from the mainland, the water containing iron and lime.

The scientific Name of the Osage Orange.— The Osage Orange, although it has borne in the past a variety of scientific names, appears to have no designation which is in accord with the Vienna Rules. These legitimize the generic name *Maclura* of Nuttall but necessitate the restoration of the earlier specific name of Rafinesque. The needed binomial and its synonymy are as follows:—

Maclura pomifera (Raf.), n. comb.

Ioxylon pomiferum Raf. Am. Monthly Mag. ii. 118 (1817).

Maclura aurantiaca Nutt. Gen. ii. 233 (1818).

Broussonetia tinctoria Spreng. Syst. iii. 901 (1826) in part, not HBK.

Toxylon aurantiacum Raf. Med. Fl. ii. 268 (1830).

T. Maclura Raf. New Fl. N. A. iii. 43 (1836).

Toxylon pomiferum Sarg. Silv. vii. 89 (1895).

B. L. Robinson.

Alchemilla pratensis found at Westford, Massachusetts.— Some months ago I noticed a plant at Westford, Massachusetts, which I identified as an *Alchemilla*. To be quite sure of the determination I sent a specimen to the Gray Herbarium, but even there a positive specific identification could not be made until some identical specimens from Nova Scotia had been forwarded to Dr. Buser, of Geneva, a well known specialist on the genus. Dr. Buser pronounced the plant *A. pratensis* F. W. Schmidt. I am informed that this European species has become well established and abundant in several parts of Nova Scotia, but seems not to have been noticed in New England. It is therefore suggested that its occurrence at Westford, however casual, is of sufficient interest to be recorded in order that botanical collectors may be on the outlook for other New England stations. The species was found in a neighbor's back yard, where chickens were kept, and the most natural supposition is that the seed was introduced with chicken-feed. There were in all five individuals, one large and the others apparently recent seedlings from it. Although the flowers are small and inconspicuous the species is an attractive one, and in our flora it will be pretty easily recognized by its orbicular deeply cordate and shallowly 7–9-lobed leaves. — Emily F. Fletcher, Westford, Massachusetts.

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THE OLDER TYPES OF NORTH AMERICAN VIOLETS.—I.

E. BRAINERD.

AN earnest effort has been made to ascertain what specific types were before the older students of Viola when they published their American species. The task is indeed a difficult one, as the type specimen is usually not extant, and the description often brief and inadequate. In some instances it would seem that the problem must be abandoned as insoluble. But as we get a clearer knowledge of our plants in the field, and learn to distinguish specific differences from fluctuating variability, we may hope also to make progress in identifying the older specific names. Fortunately, absolute proof is not necessary; if we can get nothing better, we may be content with a reasonable degree of probability.

V. OBLIQUA Hill (Hortus Kew. 1769.) In the judgment of many students of the genus, this, the oldest name for one of our cordate-leaved violets, though published with a figure, is hopelessly vague. A species so ill-defined that Pursh could think that *V. blanda* was intended, Schweinitz that it stood for *V. cucullata*, and LeConte that it might be *V. rotundifolia,*— not to speak of its recent interpretation as *V. papilionacea* and *V. affinis,*— must surely be discarded as past recognition.

The status of the three allied species, V. CUCULLATA, V. PAPILIONACEA and V. AFFINIS, is much alike, and they may be best discussed together. It is now less than a decade since Prof. Greene put forth his interpretation of these old species, which for over sixty years had been merged into one. We could wish that the proof were more positive as to what Aiton, Pursh, and LeConte had before them, when giving these several names; but recent students of Viola seem

convinced that the weight of evidence sustains Prof. Greene's conclusions. Aiton's statement regarding *V. cucullata,* that the lateral petals are longer than the spurred petal, is to me a strong indication that we have correctly identified his species. Schweinitz had a most distinct and accurate conception of the plant, but unfortunately regarded it as *V. obliqua* Hill. LeConte used instead, for the very same plant, the far less ambiguous name of Aiton, *V. cucullata*; but he gave *V. papilionacea* only varietal rank, and separated from these his *V. affinis* with such hesitancy, as not to carry conviction. "Too near the preceding," (*V. cucullata*), he says, "I can find no distinctive characters except the shorter peduncles and the broader sepals." Yet he strangely overlooks a better mark of difference, expressly stated in his descriptions, that in *V. cucullata* the spurred petal is generally naked and glabrous, (superiore [petalo] ut plurimum nudo, glabro); while in *V. affinis* it is generally villous, (superiore ut plurimum villosa). After all, as Greene remarks, LeConte's drawing, still extant, is the best evidence as to what plant he had in mind.

When, however, Torrey and Gray published the first fascicle of their North American Flora, in July, 1838, *V. papilionacea* and *V. affinis* were cited as mere synonyms of *V. cucullata*; and there the matter rested till recent years. How may we account for the wide divergence between this judgment and that of to-day? Is it not due largely to the fact that formerly this group of plants were studied only in their vernal state? The three species under discussion are small stemless herbs; in spring we see nothing above ground but half-grown leaves, and scapes bearing single flowers, all much alike. Only in late summer are marked specific characters developed; then the mature leaves, the apetalous flowers, their peduncles, sepals, capsules and ripe seeds, all reveal striking differences. The plants in petaliferous flower furnished to the early botanists only vague, hardly definable hints of specific distinctness; even Torrey and Gray could see no notable differences. But when the growing plants are at hand in late summer, a child can be taught to distinguish the species.[1]

Viola sororia Willd. was published in 1806 in the Hortus Berolinensis with a detailed description and an excellent plate (no. 72). It

[1] Dr. Gray in later years was doubtless influenced in the reduction of violet species by his knowledge of the numerous intergrading forms, that connect the extreme types of the *cucullata-sagittata* group. Whether he thought this due to recent interbreeding, or not, it would support his conception of a "most polymorphous" species.

is therefore surprising that it was so constantly misinterpreted or ignored, until correctly understood in the Illustrated Flora (1897). The description calls for a stemless, violet-flowered plant, with cordate leaves pubescent beneath and on the petioles. The only two species in eastern North America combining these characters are the one to which Dr. Britton has applied the name *V. sororia,* and the northern *V. septentrionalis.* The latter is quite unlikely to have reached Berlin; and furthermore its vernal leaves in outline and aspect do not answer as well to the Willdenow plate, as do those of the Britton plant. The confusion of the older botanists regarding Willdenow's *V. sororia* may be due in part to a palpable blunder in his description, for he calls the spurred petal bearded, and the lateral petals smooth. I say 'palpable blunder' for there is not a known violet in eastern North America that bears such a flower. Through some error of observation or of memory (not without parallel) Willdenow located the beard on the wrong petal.

The first misapplication of the name *V. sororia* was made by Nuttall, who quotes it as a synonym of *V. villosa* Walt. Nevertheless. after describing his *V. villosa* var. *cordifolia,* he somewhat inconsistently remarks, that this *latter* "is decidedly the *V. sororia* figured in the Hortus Berolinensis, although the leaf is said to be pubescent beneath instead of above." Schweinitz, Torrey and LeConte perpetuate in one form or the other the error of Nuttall.

The genuine *V. sororia* Willd. was, however, too common a plant not to have been noticed under some name. The oldest synonym is the *V. asarifolia* of Pursh.[1] This was based upon a plant of low rich woods, collected in the Carolinas by Catesby in 1724,— still to be seen at Oxford in hb. Sherard. A tracing made by Prof. Fernald shows it to be a summer specimen having large tall leaves, and bearing cleistogamous flowers and an immature capsule on peduncles less than two inches long. It is so unlike the form ordinarily seen in vernal flower, that Pursh, though recognizing *V. sororia* Willd., makes the Catesby plant another species;— a blunder made by more than one botanist, who has thought to get an adequate notion of a violet by studying it only when in petaliferous flower. Pursh adds the naïve remark, "I have seen this species several times in Virginia, but generally without flowers; which has been the reason that no specimen was in my collection."

[1] Supplement to Flora, ii. 734, 1814.

LeConte also recognized the plant under two different names. It is (1) his *V. cucullata* var. γ, as both his description and one of his figures clearly show; and (2) "*V. asarifolia* Pursh," perplexingly said to have very large villous leaves, short peduncles scarcely over an inch and a half long [aestival conditions], a naked glabrous spurred petal, and for habitat Canada and northwestern New York. [? sc. and southward.]

In recent years Willdenow's plant has been variously disposed of; Mr. Witmer Stone regards it as a form of *V. palmata dilatata* Ell.; and for Prof. Greene it has furnished material for at least four new species,— *V. laetecaerulea*, *V. cuspidata*, *V. nodosa*, and *V. Dicksonii*.

V. villosa Walter. This name was applied by the older American botanists to two quite distinct species. Elliott and LeConte, who were intimately acquainted with the plants of Walter's region, understood him to refer to a violet, found only south of Virginia, chiefly in pine-barrens,— densely and finely pubescent throughout,— a species allied to *V. fimbriatula*, and published in 1898 by Prof. Greene as *V. Carolina*. But Nuttall, and after him Schweinitz and Torrey, applied the name to a violet that grows on dry slopes among deciduous trees from southern New York to Georgia, chiefly along the eastern foothills of the Appalachian Mountains,— a small species allied to *V. papilionacea*,— marked by somewhat rigid silvery pubescence on the upper surface of the leaf, though elsewhere glabrous. Which of these two plants is the *V. villosa* of Walter? That it is the first of the above described species, can be shown I think beyond a reasonable doubt. I would present the three following points for consideration.

1. Walter tells us in his preface that nearly all the species in his Flora Caroliniana were found in a tract that might be bounded by a line of fifty miles. His house and the botanical garden, in which he was buried, were on the banks of the Santee River, near the middle of the great tide-water plain of the southern Atlantic States. No specimen of the upland plant, *V. villosa* of Nuttall, has ever been found in this tract or within a hundred miles of the home of Walter. But the other species, as I can testify after a recent visit, is here most abundant; frequent colonies occur along the old Charlestown road from Eutawville to the Walter plantation; it was seen on railway embankments and even in the streets of towns like Summerville. The plant could hardly have escaped the observation of Walter; and if noted in his Flora, it was surely under the name *V. villosa*.

2. This descriptive term better characterizes the plant of the lowlands than that of the uplands. The pubescence of the former is, indeed, rather short for the precise use of the word 'villosa'; but it is dense and soft, that of the petioles and peduncles being, as Prof. Greene puts it, "almost plushy." Mr. Pollard also says of it in Small's Southern Flora, "petioles usually densely villous."[1] But of the upland plant Prof. Greene remarks, "the accepted *V. villosa* is not villous; it is rather stiffly hirsutulous."

3. The opinions of Elliott and of LeConte are entitled to great weight regarding the point in question. Through the kindness of Prof. Paul M. Rea, the Curator of the Charlestown Museum, I had the privilege of examining the specimens of Viola in the Elliott herbarium, and found the plant that he had labelled *V. villosa* Walt. to be the species of the coastal plains. LeConte, than whom no botanist in the first half of the last century more diligently studied and more accurately discriminated the perplexing forms of Viola in the Atlantic States, is most emphatic in applying Walter's name to the plant of the coastal region, and not to the plant of the northern uplands. "When *V. villosa* is misunderstood," he justly remarks, alluding to Nuttall and Torrey, "it is simply by authors who have never seen it."[2] LeConte's description of the two species as well as his accurate figures, now in the possession of Prof. Greene, confirm these conclusions. This interpretation of *V. villosa* was adopted in Torrey and Gray's No. Am. Flora, in 1838, and is the one maintained in all the many editions of Eaton's Botany published after 1830.

The true *V. villosa* Walt. has the unique habit of bearing apetalous flowers and fruit in the winter and early spring, before bearing petaliferous flowers. Much of the autumn foliage remains green through the winter, and specimens that I collected the last week in March had abundance of ripe seed but no petaliferous flowers. In no. 31 of Greene and Pollard's distribution of No. Am. Violaceae are to be seen both flowering and fruiting specimens of this species, collected March 30 and April 19; but the fruit is from cleistogamous flowers and was evidently obtained on the earlier date, the flowers on the later.

The other species, that is currently passing as *V. villosa*, will need

[1] It should be understood that both these authors are here speaking of *V. Carolina*, apparently not suspecting it to be Walter's *V. villosa*.

[2] "Cum *V. villosa* confusa, auctoribus duntaxat quibus nunquam visa." Ann. N. Y. Lyceum, ii. 144.

to have a name of its own, and I would designate it by a similar epithet descriptive of its upper leaf-surface:—

Viola hirsutula, nom. nov. (*V. villosa* Nutt. and recent authors, not Walter; *V. sororia* LeConte and Eaton, not Willdenow).

V. villosa var. *cordifolia* Nutt. has been a source of more or less confusion. Judging from the very full description in both Nuttall and Schweinitz, it was probably based on a hybrid between *V. hirsutula* and *V. papilionacea*, found in "dry woods on the banks of the Schuylkill near Philadelphia." Such a hybrid, from two stations now within the limits of that city, I have had growing for two seasons. The plants were found in company with the two above named species, possess intermediate characters, and show much impaired fertility. But their hybrid origin is positively demonstrated by the behavior of their seedlings, which presented last summer, in strikingly diverse forms, the divergent characters of the parents. For example, some seedlings had the small leaves of *V. hirsutula*, others the large leaves of *V. papilionacea*; some bore purple capsules like *V. hirsutula*, others light green capsules like *V. papilionacea*; some produced the pale yellow seeds of *V. hirsutula*, others the almost black seeds of *V. papilionacea*. This bybrid has also been collected by Mr. W. DeW. Miller in Plainfield, N. J.; and by Prof. House in the District of Columbia, and was published by him in Rhodora viii. 121, as *V. papilionacea* × *villosa*. It should rather be designated:—

V. hirsutula × papilionacea. (*V. villosa*, var. *cordifolia* Nutt.; *V. cordifolia* Schweinitz; *V. villosa*, var. *cordata* Torr., Flora i. 252, 1824; the change in varietal name being plainly an inadvertence.)

Middlebury College, Middlebury, Vermont.

CATHARINAEA MACMILLANI.

Edward B. Chamberlain.

(Plate 74.)

In the spring of 1906 Miss A. L. Crockett of Camden, Maine, sent the writer a small package of mosses. On account of other duties, the specimens were not examined closely at the time. Last November, however, when the subject was again taken up, it was found that

one packet contained fruiting material of a *Catharinaea* which seemed totally unlike any species described in the current manuals. The plant was conspicuous by its small size, stiff erect habit, and its crisped, closely inrolled leaves. Microscopic study showed it to differ from the other species of the genus in its papillose leaves with numerous, large lamellae. By comparison with specimens at the New York Botanical Garden, the specimen was determined as *Catharinaea Macmillani*, a species described in 1903 by Prof. J. M. Holzinger from sterile plants collected at Ortonville, Minnesota. This determination has since been verified by Prof. Holzinger. Search in the herbarium of the New York Botanical Garden brought to light several specimens from the herbarium of the late C. F. Austin, which in all essential characteristics agreed with the plant in question. Some of these specimens bore a manuscript name, which shows that Austin had already noticed the peculiarity of the plant.

The plants show some variation in size, and in the number and height of the lamellae; but are at once distinguishable by the papillosity of the leaves and lamellae, a character which seems to be unique in the genus. Since the original collection was sterile, and the characterization of the species brief, it seems best to publish here a full description, drawn from the fruiting specimens collected by Miss Crockett, and verified by comparison with a fragment from the original collection. The species is most closely related to *Catharinaea angustata*, Brid., of which it might be regarded as a derivative due to exposed conditions. My thanks are especially due to Mrs. E. G. Britton, Prof. Holzinger, and Prof. J. F. Collins for assistance in the study of the specimens.

Catharinaea Macmillani, Holzinger. Minn. Bot. Studies. Ser. **3**: Part II: 120. (1903). *Dioecious*, archegonia in the axils of the inmost comal leaves. *Gametophyte* 2–2.5 cm. high, dull olive or reddish green, brownish below. Stems erect, simple or branched from near the base, naked or with a few rhizoids below. Lowest leaves scale-like and feebly developed, gradually larger and forming irregular rosulate tufts above, patent when moist, crisped and somewhat spirally contorted when dry, oblong-linear, 2–3 × 0.5 mm., not sheathing at the base, slightly undulate in the upper third, with 2–3 oblique rows of strong dorsal teeth, acute, often ending in a spiny point. Margin of two rows of linear, thickened cells in two layers, serrate in the upper third, the teeth double and becoming more prominent toward the apex. Costa stout, semiterete, about one fifth the median width of the leaf, percurrent or nearly so, composed in cross-

section of a dorsal row of thick-walled, papillose cells, two stereid bands separated by a double row of median guides, and a ventral row of larger cells from which arise 5–9 lamellae. Lamellae minutely crenulate in side view, 6–10 cells high, terminal cell wall not noticeably thickened, but usually with 2–3 low papillae. Leaf-cells round-hexagonal above, strongly chlorophyllose, becoming more hyaline and rectangular below, median cells 12–16 μ in diameter, somewhat moniliform in section, usually with 1–3 low papillae on each surface. *Sporophyte*, usually solitary, occasionally two. Seta 30–50 mm. long slender, smooth, brownish. Capsule 1.5–2.5 × 0.5–0.7 mm., cylindric, tapering slightly at the base, erect, straight or slightly curved, smooth, areolation rectangular below with the lateral walls much thickened, five or six rows of the cells at the orifice quadrate and incrassate, darker colored. Operculum convex, rostrate, beak at times three-quarters as long as the urn, deep red. Calyptra cucullate, equalling urn, rough at the apex. Peristome nematodontoid, of 32 linear, acute, papillose teeth, from a basal membrane one third the total height, central portion red, margin pale and minutely crenulate, attached by apices to the epiphragm.

Plate 74, figures 1–9.

Illustration: Holzinger, loc. cit. pl. 19.

Habitat: dryish, sterile soil, often in large turfs.

Distribution: Ortonville, Minn., *J. M. Holzinger*, 1901. (type). Camden, Maine, *A. L. Crockett*, No. 163. 1903. North Haven, Conn., *G. E. Nichols*, 1907. Camden, N. J., *Parker*. Closter, N. J., *C. F. Austin*. Salina Co. Missouri, 1890, *C. H. Demetrio*.

New York City.

Explanation of Plate 74.

Fig. 1. Plant in dry condition, natural size.
Fig. 2. Portion of a moistened plant, × 6.
Fig. 3. Leaves from upper, median, and lower parts of the stem, × 12.
Fig. 4. Apex of leaf from back, × 25.
Fig. 5. Areolation of upper margin, median leaf, × 225.
Fig. 6. Areolation of basal margin, median leaf, × 225.
Fig. 7. Outline median cross-section of leaf, × 50.
Fig. 8. Detail of same cross-section, × 225.
Fig. 9. Portion of peristome, × 50.

A SYNOPSIS OF THE NEW ENGLAND SPECIES OF PLEUROTAENIUM.

Joseph A. Cushman.

(Plate 75.)

While the New England desmids have had much less attention given to them than has been given to those of the British Isles, there are nevertheless ten species of *Pleurotaenium* known from New England. There are but nine species of *Pleurotaenium* given in Wests' British Desmids. Four of our species have not been reported from the British Isles. The species are all comparatively large and conspicuous and are easily distinguished from one another. They fall naturally into three groups. The majority of the species of the genus have straight sides or in certain cases slightly undulate. The species of the second group including *P. nodosum* and *P. constrictum* have definite enlarged portions or annulations. The third group is represented by the single species *P. verrucosum,* which has the surface divided into rectangular areas in more or less distinct rings. Our species with their several varieties are given below and their distribution in New England as far as known. The records followed by an exclamation point are those from which specimens have been seen by the writer. In most points the recent monograph of the Wests has been followed. A key to the New England species is given here, based in part upon that of the Wests.

Pleurotaenium Nägeli, 1849.

Cells cylindrical, circular in end view, sides straight or somewhat sinuate; semicells with a basal inflation and often with secondary ones distally, apex truncate, usually with a ring of tubercles; chloroplasts several, in irregular longitudinal bands parietally arranged.

Key to the New England Species of Pleurotaenium.

I. Cells cylindrical or slightly attenuated, end view circular, sides nearly straight or very slightly sinuate toward the base of the semicell, or evenly curved from base to apex, not prominently sinuate and without a thickened surface pattern.

1. Apices furnished with a ring of tubercles.
   A. Cells broadest at or near base of semicells.
      a. Cells 10–15 times as long as wide . . . *P. coronatum.*
      b. Cells 6–9 times as long as wide . . . . *P. truncatum.*
      c. Cells 15–18 times as long as wide. . . . *P. Ehrenbergii.*
   B. Cells broadest in middle of semicells. . . . *P. subgeorgicum.*
2. Apices usually without tubercles.
   A. Cells of medium size, basal inflation not usually prominent. *P. Trabecula.*
   B. Cells very large, basal inflation prominent. *P. maximum.*

II. Cells with a surface pattern of quadrilateral thickenings, ends circular. *P. verrucosum.*

III. Cells with a few broad constricted areas, sides very sinuate. *P. constrictum.*

IV. Cells with rings of nodules, end view sinuate-stellate. *P. nodosum.*

Pleurotaenium coronatum (Bréb.) Rabenh., Flor. Europ. Algar., III, 1868, p. 143; *Docidium coronatum* Bréb., in Ralfs, Brit. Desm., 1848, p. 217, Pl. XXXV, f. 6; Wolle, Desm. U. S., 1884, p. 49, Pl. XI, f. 9–10. Cells large, 10–15 times as long as wide, gradually attenuated from base to apex, prominent basal inflation, sides undulate, apex truncate with 6–8 blunt tubercles. Length 340-575 μ; breadth at base 34–63 μ; apex 27–40 μ.— Me.: Bridgeton! N. H.: Noone's Station!; Pudding Pond, North Conway! Mass.: Lake Quinsigamond, Worcester (*Stone*); Plainville! Randolph! Bridgewater!

P. coronatum var. fluctuatum West, Jour. Linn. Soc. Bot., Vol. XXIX, 1892, p. 118, Pl. XIX, fig. 11. Cells considerably larger than in the typical form, 12–14 times as long as broad, sides of semicells undulate for their entire length. Length 850–900 μ; breadth at base 65–72 μ; apex 46–50 μ — N. H.: Intervale! Mass.: Lake Watuppa, Fall River! This is one of the largest of our desmids and is easily visible without a lens. It is not common.

P. coronatum var. nodulosum (Bréb.) West, Jour. Linn. Soc. Bot., Vol. XXIX, 1892, p. 119. *Docidium nodulosum* Bréb. in Ralfs, Brit. Desm., 1848, p. 155, Pl. XXVI, fig. 1. Semicells with the basal inflation and apical tubercles much reduced. Length 560 μ; breadth at base 65 μ; apex 46 μ.— Mass.: Amherst (*W. West*); Salem (*Bailey*). R. I.: Wainskut pond, North Providence (*Bailey*). I have not found this variety myself in New England although it has several times been reported by others. The measurements are given from an Ohio specimen which was typical.

P. TRUNCATUM (Bréb.) Näg., Gatt. Einz. Alg., 1849, p. 104. *Closterium truncatum* Bréb. in Chev., Micr., 1839, p. 272. *Docidium truncatum* Bréb. in Ralfs, Brit. Desm., 1848, p. 156, Pl. XXVI, fig. 2; Wolle, Desm. U. S., 1884, p. 48, Pl. IX, figs. 6 & 7. Cells large, 6–9 times as long as wide, decidedly attenuated towards the apex, 11–15 apical tubercles, their bases depressed below the actual end of the semicell; cell wall coarsely punctate. Length 450–520 μ; breadth 53–80 μ; apex 37–45 μ.— Me.: Orono (*Harvey, W. West*). Mass.: Pondville! Carver's Pond, Bridgewater! This does not appear to be common in New England, as it has appeared in but two of the many lots of material examined. It seems to be common in the British Isles, however, and has a wide distribution elsewhere.

P. EHRENBERGII (Bréb.) DeBary, Conj., 1858, p. 75. *Docidium Ehrenbergii* Bréb. in Dict. Univ. Hist. Nat., 1844, Vol. V, p. 93. Cells of medium size, 15–18 times as long as wide, somewhat attenuated towards the apices, a basal inflation and one or two additional ones above it; apices with 7–9 tubercles, cell wall punctate. Length 350–496 μ; breadth 21–32 μ; apex 12.5–19 μ.— Mass.: Tewksbury (*Lagerheim*)! Randolph! Halifax! Lake Watuppa, Fall River! Nantucket! Although this is the most frequent species of the genus in the British Isles according to the Wests, in New England there are other species that occur more frequently.

P. EHRENBERGII var. ELONGATUM West, Jour. Linn. Soc. Bot., Vol. XXIX, 1892, p. 119. Cells narrow and much elongated, about 25 times longer than the diameter. Length 573–660 μ; breadth 25–30 μ; apex 19–22 μ.— N. H.: Pudding Pond, North Conway! Mass.: Halifax!

P. EHRENBERGII var. UNDULATUM Schaarschm., Magyar Tudom. Akad. Math. s. Termeszettud. Kozlemenyek., Vol. XVIII, 1882, p. 278, Pl. I, fig. 21. Cells larger than in the typical form and with the sides undulate throughout their length. Length 496 μ; breadth 25 μ; apex 15 μ.— N. H.: Pudding Pond, North Conway!

P. TRABECULA (Ehrenb.) Näg., Gatt. Einz. Alg., 1849, p. 104, Pl. VI, fig. A. *Closterium Trabecula* Ehrenb., Beitr. zur Kentniss der Organis. der Infus., 1830, p. 62. *Docidium Trabecula* Wolle, Desm. U. S., 1884, p. 48, Pl. IX, figs. 2–4, Pl. XII, figs. 1–7. Cells large, 9–19 times as long as wide, sides of semicells nearly straight, apices rounded truncate, usually without tubercles. Length 320–620 μ; breadth at base 25–44 μ; apex 23–27 μ.— Me.: Orono (*Har-*

vey); Kittery, common! N. H.: North Woodstock! Noone's Station! Mass.: Near Salem (*Bailey*); Amherst (*W. West*); Reading! Plainville! Carver's Pond, Bridgewater! Long Pond, Tewksbury! Nantucket!

P. Trabecula forma granulatum G. S. West, Jour. Bot., Vol. XXXVII, 1899, p. 113, Pl. CCCXCVI, fig. 6. "Cell wall distinctly and irregularly granulate." Length 505 μ; breadth at base of semicells 34 μ; apex 28 μ.— N. H.: Mt. Moosilauke!

P. Trabecula forma clavatum (Kütz.) W. & G. S. West, Bot. Trans. Yorks. Nat. Union, Vol. V, 1902, p. 58. *Docidium clavatum* Kütz. in Ralfs, Brit. Desm., 1848, p. 156, Pl. XXVI, fig. 3; Wolle, Desm. U. S., 1884, p. 48, Pl. IX, fig. 8. "Cells about 12 times longer than their diameter; semicells slightly tumid and subclavate." Length 360 μ; breadth at base, 31 μ; apex 25 μ.— Mass.: West Bridgewater!

P. Trabecula var. rectum (Delp.) W. & G. S. West, Brit. Desm. Vol. I, 1904, p. 212, Pl. XXX, figs. 9–10. *Pleurotaenium rectum* Delp., Mem. R. Accad. Scienze di Torino, ser. 2, Vol. XXX, 1877, p. 129, Pl. XX, figs. 8–11. Cells smaller than the typical, 12–15 times as long as wide. Length 250 μ; breadth at base of semicells 18.5 μ; apex 15 μ.— N. H.: North Woodstock! Mass.: North Eastham (*F. S. Collins*)!

P. subgeorgicum Cushman, Rhodora, Vol. VII, 1905, p. 117, Pl. LXI, fig. 4. Cells large, 12–15 times as long as wide, semicells widest at a point more than midway from the isthmus, thence tapering gradually to either end; basal portion with several inflations, remaining portion of the sides smooth; apex truncated, with a crown of 10 bluntly rounded tubercles. Length 600–700 μ; breadth at base 30–35 μ; at middle of semicells 45–58 μ; apex 25–30 μ.— N. H.: North Woodstock!

P. maximum (Reinsch) Lund., Nova Acta Reg. Soc. Scient. Upsala, ser. 3, Vol. VIII, 1871, p. 89. *Docidium maximum* Reinsch, Spec. Gen. Alg., 1867, p. 140, Pl. XX. C, figs. 1–2. *D. Archeri* Wolle, Desm. U. S., ed. II, 1892, p. 51, Pl. XII, fig. 2. Cells large, 14–18 times as long as wide; apices truncate with rounded angles; prominent basal inflation. Length 600–850 μ; breadth at base 40–55 μ; apex 22–30 μ.— Me.: Orono (*W. West*). Mass.: Amherst (*W. West*).

P. indicum (Grun.) Lund., Nova Acta Reg. Soc. Scient. Upsala, ser. 3, Vol. VIII, 1871, p. 90. *Docidium indicum* Grun., Desmid. Banka, 1865, p. 13, Pl. II, fig. 18. Length 630 μ; breadth at base

21 μ; apex 16 μ.— Mass.: Tewksbury (*Lagerheim*). This species rests upon this record and could not be verified although many of the records of Lagerheim have been gone over by the writer from some of the material from which Lagerheim took his desmids. For the present it must remain as a single record.

P. CONSTRICTUM (Bail.) Wood, F. W. Algae N. Am., 1873, p. 121. *Docidium constrictum* Bail. in Ralfs, Brit. Desm., 1848, p. 218, Pl. XXXV, fig. 7. Wolle, Desm. U. S., 1884, p. 50, Pl. XI, fig. 2. Cells large, 12–15 times as long as wide, very slightly attenuated from base to apex; a prominent basal inflation and three or four others in each semicell; apices truncate with a peripheral ring, usually 8 large bluntly pointed tubercles, membrane evenly punctate; basal inflation occasionally with small plications, usually 8 in number. Length 435–560 μ; breadth at base 40–50 μ; apex 25–32 μ.—N. H.: Laconia, scarce, (*Wests*); Pudding Pond, North Conway! Mass.: Tewksbury (*Lagerheim*). R. I.: Worden's Pond, North Providence (*Bailey*).

P. NODOSUM (Bail.) Lund., Nova Acta Reg. Soc. Scient. Upsala, ser. 3, Vol. VIII, 1871, p. 90. *Docidium nodosum* Bailey in Ralfs, Brit. Desm., 1848, p. 218, Pl. XXXV, fig. 8. Wolle, Desm. U. S., 1884, p. 50, Pl. XI, figs. 11–12, Pl. XII, fig. 20. Cells large, 7–10 times as long as wide, semicells with rings of nodules, usually four in number including the basal ring and equidistant, 6–8 nodules in each ring; apices dilated, with a ring of 6–8 tubercles. Length 300–460 μ; breadth at base 40–70 μ; apex 28–40 μ.— Me.: Orono (*Harvey*). N. H.: Laconia (*Wests*); Pudding Pond, North Conway! Intervale! Noone's Station! Mass.: Near Salem (*Bailey*); Lake Quinsigamond, Worcester (*Stone*); Carver's Pond, Bridgewater! R. I.: Wainskut Pond, North Providence (*Bailey*). This seems to be one of the commonest species of the genus in New England. It is rare in the British Isles.

P. VERRUCOSUM (Bail.) Lund., Nova Acta Reg. Soc. Scient. Upsala, ser. 3, Vol. VIII, 1871, p. 6. *Closterium verrucosum* Bail., Am. Jour. Sci., n. s. Vol. I, 1846, p. 127, fig. 4. *Docidium verrucosum* Bail. in Ralfs, Brit. Desm., 1848, p. 218. Wolle, Desm. U. S., 1884, p. 52, Pl. X, figs. 4–5. Cells of medium size, about 10-15 times as long as wide, semicells with straight sides, slight inflation at the base, cell wall with 13–15 rings of irregularly quadrilateral areas, the last ring distally more elongated than the others. Length 400-460 μ; breadth at base 30–40 μ; apex 22–30 μ.— N. H.: Pudding Pond, North Conway, frequent! Mass.: Mt. Everett (*Wolle*). R. I.: Near Providence (*Bailey*).

Explanation of Plate 75.

Fig. 1.	Pleurotaenium	coronatum (Bréb.) Rabenh., × 351.
Fig. 2.	"	truncatum (Bréb.) Näg. (after W. & G. S. West) × 310.
Fig. 3.	"	Ehrenbergii (Bréb.) DeBary, × 350
Fig. 4.	"	Trabecula (Ehrenb.) Näg., × 350.
Fig. 5.	"	subgeorgicum Cushman, × 350.
Fig. 6.	"	constrictum (Bail.) Lund., × 350.
Fig. 7.	"	nodosum (Bail.) Lund., × 350.
Fig. 8.	"	verrucosum (Bail.) Lund., × 350.

Streptopus oreopolus a possible hybrid.— In April, 1906, I described from the alpine region of Mt. Albert, Gaspé Co., Quebec, as *Streptopus oreopolus*[1] a plant which in some ways combined characteristics of *S. amplexifolius* and *S. roseus*, but in its deep claret-colored perianth was unlike either. The original description was based upon simple or subsimple alpine specimens, and at that time the plant was known only from a limited area on Mt. Albert.

During the summer of 1906, however, Professor J. Franklin Collins and the writer found *Streptopus oreopolus* in company with *S. amplexifolius* and *S. roseus* abundant along alpine brooks on the northern hornblende slopes of Mt. Albert, and in extreme abundance everywhere on alpine meadows and in the open park-like subalpine forests of the granitic tableland of Table-top Mountain. In fact, on Table-top Mountain *S. oreopolus* impresses one as perhaps the most abundant plant of the cool slopes and alpine meadows, always more abundant than *S. roseus* and *S. amplexifolius*, maintaining its slightly ciliate-hispid stems and leaves (pronouncedly less ciliate than in *S. roseus*) and its attractive flowers, in form and structure like those of *S. amplexifolius* but always a deep claret-purple in color.

Since the fruit of this local plant of the Gaspé mountains was still unknown we took special interest in examining daily, through our four weeks' residence in the alpine areas, the colonies of *Streptopus*. The result of a very close observation of the plants over an area of about one hundred square miles was that, while both *S. roseus* and *S. amplexifolius* were found to mature abundant fruit, not a single plant of *S. oreopolus* could be found with even a vestige of good fruit. In

[1] Rhodora, viii, 70 (1906).

fact, all the plants examined had merely dry shriveled and hollow ovaries. This uniform sterility of *S. oreopolus* throughout its known range suggests that it may not be a self-perpetuating species; yet, if this should prove to be the case, the profusion of the plant throughout the area and the constancy with which it maintains its characteristic pubescence and the color of its perianth is indeed remarkable. It is of course possible that the sterility of the plants in 1906 was exceptional and due perhaps to the extremely dry weather during early summer, the valley of the lower St. Lawrence experiencing a drouth quite unprecedented in that ordinarily cold and humid region, or that it depends for fertilization upon some insect which was affected by the adverse season; but the abundant fruiting of *S. roseus* and *S. amplexifolius* indicates that the unusual dryness had no adverse effect upon those species.

It is worth recording that in the mountains of Gaspé *Streptopus amplexifolius* and *S. roseus,* as well as *S. oreopolus,* show a great variation in size. All three plants in rich subalpine woods become very tall and branched, often 1 m. or more in height, but in alpine situations they are much reduced, the simple or subsimple stems 2 or 3 dm. high.— M. L. FERNALD, Gray Herbarium.

THE THIRTEENTH ANNUAL MEETING OF THE JOSSELYN BOTANICAL SOCIETY will be held at Oxford, Maine, from Monday to Saturday, July 1–6, 1907, inclusive. The headquarters of the society will be at the Belmont Lodge Hotel, Oxford. Boats upon Thompson Lake will be at the disposal of the party and it is planned to make one all day excursion upon the lake. An opportunity will also be given to visit the famous orchid swamps at Hebron. To secure the favorable rates given below, it is absolutely necessary to know immediately how many members will attend. You are requested, therefore, to communicate your plans to the undersigned at once, whether planning to attend or not. Reduced rates of 1¾ cents per mile have been secured on the Maine Central Railroad, and its is expected that a similar rate will obtain upon the Grand Trunk Railroad. Hotel Rates: One or two in room $2.00 per day.— EDWARD B. CHAMBERLAIN, 38 West 59th Street, New York City.

Thirteenth Annual Field Meeting of the Vermont Botanical and Bird Clubs will be held at No. Pownal, Vt. on Tuesday and Wednesday, July 2 and 3. Headquarters will be at Hotel Glenwood, where the members and their friends will assemble on the evening of July 1. Tuesday, July 2, will probably be given to exploring the cliff region of Pownal Center. Wednesday, July 3, will be devoted to the bog regions of the river valley.

There are three routes which may be taken by the Vermont members in reaching No. Pownal, as follows,

Route 1, via Bellows Falls, Brattleboro, Greenfield, No. Adams, No. Pownal.

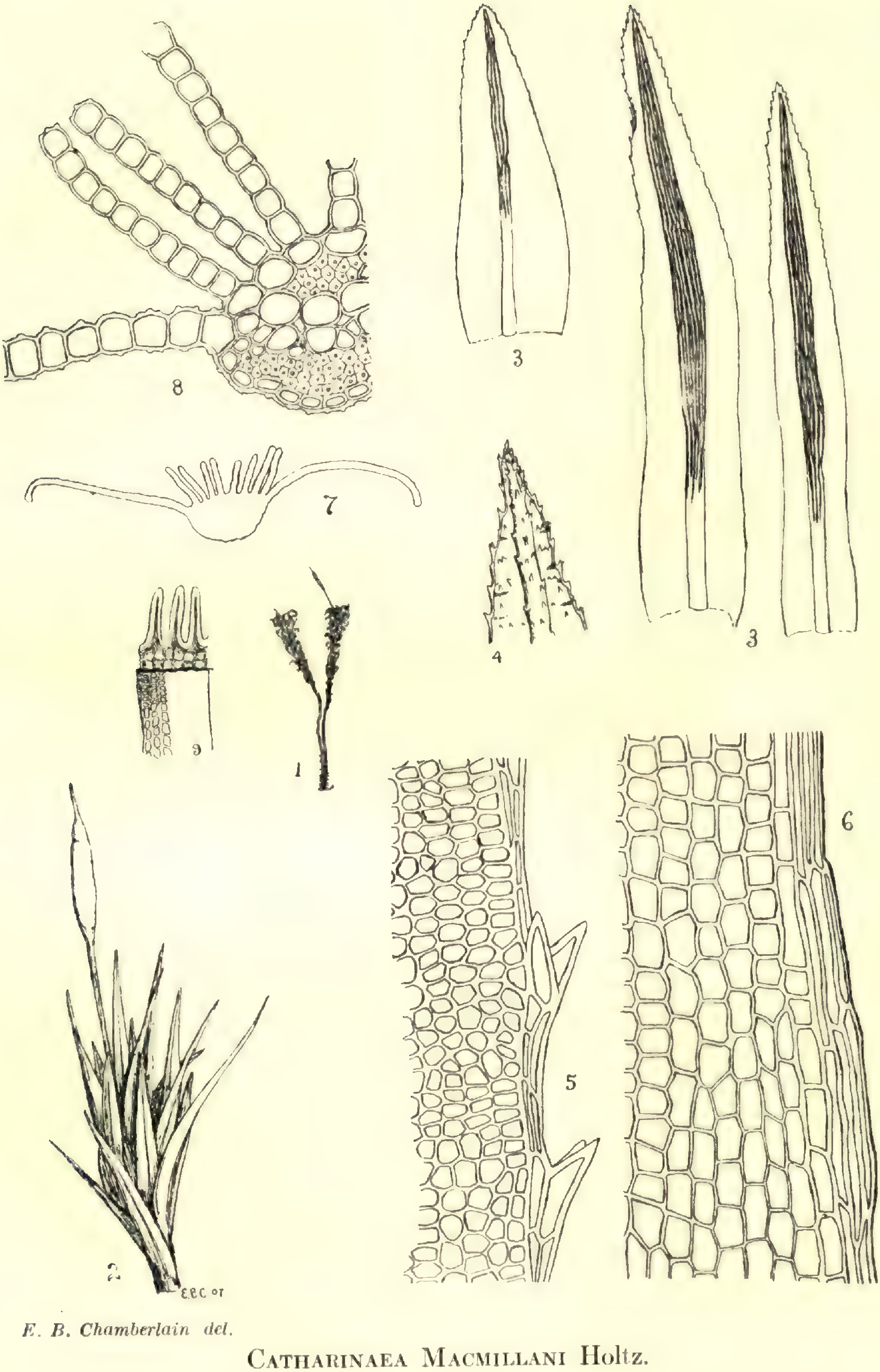
Route 2, via Rutland, No. Bennington, Hoosac Junct., No. Pownal.

Route 3, via Rutland, Castleton, Eagle Bridge, No. Pownal.

Members taking Route 2, upon reaching No. Bennington may choose between going via Hoosac Junct. to No. Pownal, or via Bennington, Petersburg Junct., to No. Pownal, or may transfer at Bennington to electric car.

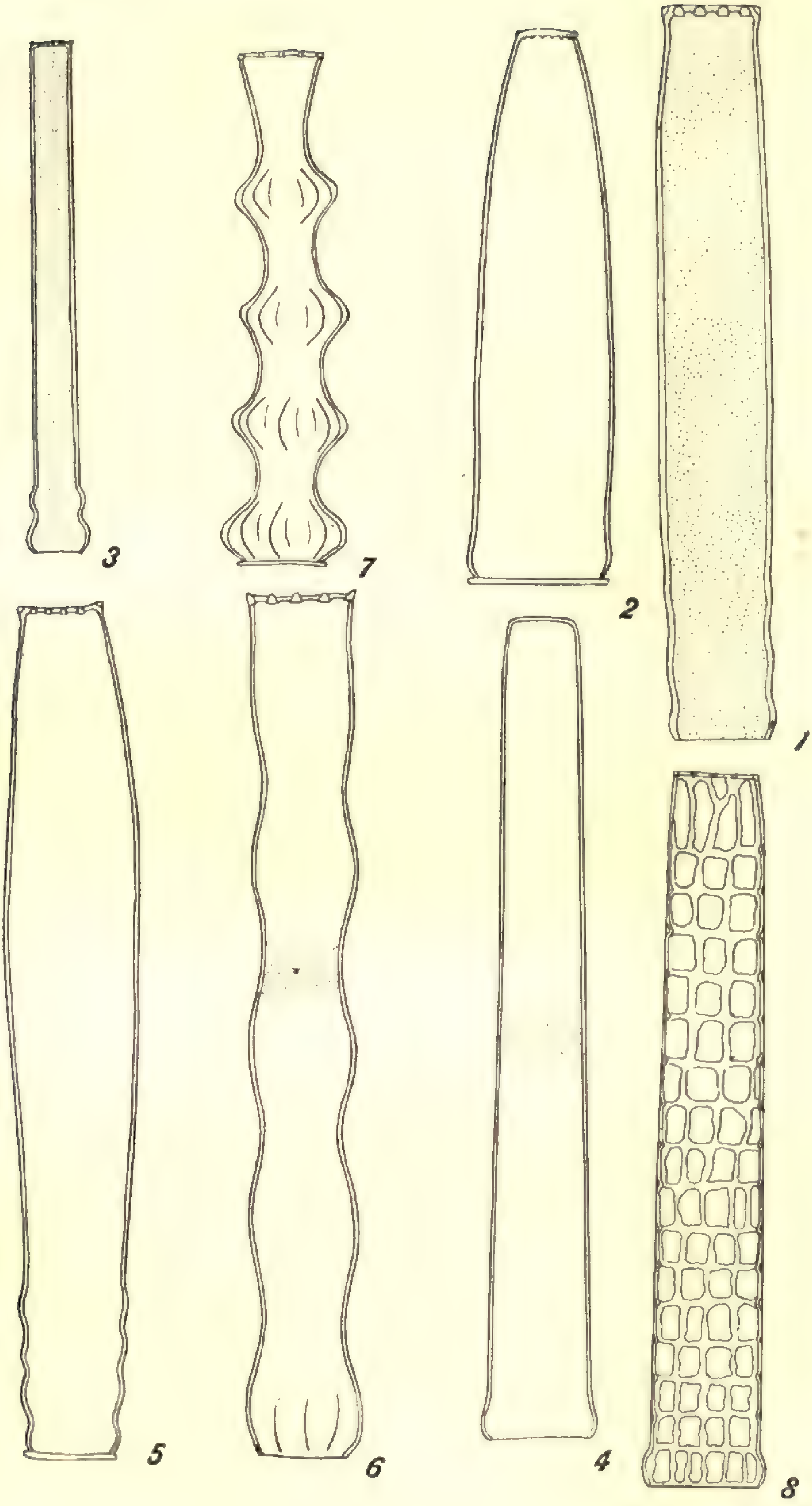
Electric cars now run through Pownal from Hoosac Junct. Williamstown and Bennington. Rates at Hotel Glenwood, $1.00 per day.— D. S. Carpenter, Sec'y Arrangements, Middletown Springs, Vt.

(*Vol. 9, no. 101, including pages 77–92, was issued 3 June, 1907.*)



E. B. Chamberlain del.

CATHARINAEA MACMILLANI Holtz.



J. A. Cushman del.

NEW ENGLAND SPECIES OF PLEUROTAENIUM

Rhodora

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SOME NEW OR LITTLE KNOWN FORMS OF NEW ENGLAND TREES.

ALFRED REHDER.

THE following descriptions of some little known varieties and forms of trees are presented here chiefly for the purpose of drawing the attention of collecting botanists to these variations. Trees and particularly the more common trees are often passed by by botanists, and therefore are usually not well represented in our collections, a fact that makes it difficult to trace the frequence of unexpected forms. We have still much to learn even in a so comparatively well explored region as New England in regard to the distribution of certain varieties and the frequence of the occurrence of certain forms of trees. That forms like the virgate form of the Red Spruce and the cut-leaved forms of Sumach due to spontaneous mutation may occur repeatedly and independently, has been shown by the observation made in Europe on allied species. We also may be on the look out for similar forms in other species or genera.

Picea mariana var. **brevifolia** comb. nov.— *P. brevifolia* Peck, Spruces of the Adirondacks, 13 (1897); Britton, Ill. Flor. **3**: 496 fig. 122a (1898); Man. 34 (1901); Brotherton, Amer. Gard. **21**: 201, 2 fig. (1900).— *P. nigra* var. *brevifolia* Rehder, Bailey's Cycl. Am. Hort. **3**: 1334 (1901).

Differs from the type chiefly in its smaller glaucous leaves. It is a small tree, rarely exceeding 10 m. in height with a narrow spire-like head of irregular outline; leaves 4–12 mm. long, stout, obtuse or mucronate, glaucous; cones 1.2–2.5 cm. long, the scales with erose margins; seeds 2 mm. long, with wings 4–5 mm. in length.

This variety is credited by Britton to Vermont, but I fail to find

in the herbariums consulted any specimens from this state. There are, however, the following specimens from Maine and New Hampshire which are referable to this variety. Maine: Bangor bog, Orono, July 20, 1892, *M. L. Fernald*; Somerset Co., peat bog, Flagstaff, Aug. 19, 1896, *M. L. Fernald*; Piscataquis Co., Mt. Ktaadn, July 8, 1900, *J. R. Churchill*. New Hampshire: summit of Thorn Mtn., Jackson, Oct. 4, 1896, *C. E. Faxon*. *Picea mariana* var. *brevifolia* inhabits chiefly mountain bogs and is distributed outside of New England to Ontario, northern New York and Michigan. The low prostrate form of the exposed tops of high mountains described by Peck as *P. brevifolia* var. *semiprostrata*, will probably also be found in New England. A form similar in habit and in the size of leaves and cones which I found on top of Mt. Mansfield in Vermont is apparently a low form of the true *P. mariana*, as it has dark green leaves.

Picea rubra forma **virgata** comb. nov.— *Picea mariana* "monstrous form" Gard. & Forest **8**: 45 fig. (1895).— *Picea rubens* "form" Sargent, Sylv. N. Am. **12**: 33 (1898).— *Picea nigra* var. *virgata* Rehder; Bailey's Cycl. Am. Hort. **3**: 1334 (1901).

Differs from the type by the long and slender branches entirely destitute of branchlets.

Massachusetts: on the base of Mt. Hopkins near Williamstown, one plant found by Mr. George Walker and specimens with a photograph sent by Samuel F. Clarke in 1894 to the Arnold Arboretum.

A very peculiar looking Spruce and interesting as a parallel form to **P. Abies** f. **virgata** (*P. excelsa* var. *virgata* Caspary), Schlangenfichte (Snake-Spruce), found in quite a number of localities in central and northern Europe, particularly in Norway. A comparison of the figure given in Garden & Forest (l. c.) of the "snake" form of *P. rubra* and of the figures of *P. Abies* f. *virgata* published by Carrière (Rev. Hort. 1854: 102) and by Schübeler (Viridarium Norwegicum **1**: 411, fig. 69. 1886 and Gartenfl. **1**: 521. 1887) show that there is hardly any difference in habit between these forms of the two species. It may be reasonably expected, that other plants of this form of *P. rubra* will be discovered in time, as the European Snake-Spruce also has been found many times, usually only in single plants which undoubtedly originated independently by mutation, and sometimes in colonies; in the latter case they were probably seedlings of a single mother tree. The offspring of the Snake-Spruce represents partly the true snake form and partly forms intermediate

between this form and the type of the species; such was at least the case in a number of seedling plants I saw in the park at Reinhardtsbrunn in the Thuringian Mountains. Trees propagated by grafting are planted occasionally in European gardens. *Picea rubra* f. *virgata* may now likewise be found in some gardens, for Prof. S. F. Clarke stated in a letter to Prof. C. S. Sargent, that Mr. G. Walker made cuttings of this Spruce. A grafted plant of this form lived in the Arnold Arboretum for years but died unfortunately a few years ago.

BETULA LENTA L. forma **laciniata** f. n.—*Betula lenta* "form" Sanford, RHODORA **4**: 83. (1902.)

A typo differt foliis inciso-lobatis, lobis utrinque 6–9 argute serratis, inferioribus circa 1 cm. longis apicem versus decipientibus et in serraturas angustas acuminis transeuntibus.

Differs from the type by the incisely lobed leaves. Leaves 6–8 cm. long, subcordate or truncate at the base, long acuminate on each side with 6–9 ovate-lanceolate, sharply serrate and acuminate lobes, the lower ones about 1 cm. long and gradually passing into the sharply serrate apex.

NEW HAMPSHIRE: New Boston, Aug. 1901, *S. N. F. Sanford* (Herb. Gray) and July 31, 1902, *E. W. Morse*, (Herb. Arnold Arboretum).

This is interesting as a parallel form to the Old World *Betula pendula f. dalecarlica* (L.) C. K. Schneider and *Betula alba* var. *urticifolia* Regel, both of which have been repeatedly found wild in Scandinavia. Of the form here described only a single tree of about 12 feet height has been found by Mr. Sanford near New Boston at an altitude of about 1200 feet as stated by him in the article referred to above. Judging from his description as well as from the specimens the tree possesses ornamental qualities which would make its introduction into our gardens desirable. This could be easily accomplished by grafting and this would be done at the Arnold Arboretum, if branches were sent late in fall or during the winter to this institution.

FAGUS GRANDIFOLIA Ehrh. forma **pubescens** Fernald & Rehder, f. n.

A typo differt foliis subtus tota facie pilosis sed marginem versus saepe glabrescentibus, ad venas villosis.

Differs from the type in having the under side of the leaves short-pubescent, but toward the margin often glabrescent and the veins covered with a villous pubescence, not with long silky hairs.

Massachusetts: South Braintree, May 30, 1907 and Bee Hill near Williamstown, June 28, 1904, *Alfred Rehder.* Rhode Island: Tiverton, Aug. 1879, *C. S. Sargent.* In cultivation at the Arnold Arboretum and also in Germany: Muskau (Silesia), Arboretum, July 23, 1901, *Alfred Rehder.*

The specimen from Rhode Island approaches the southern form by its very broad leaves and the somewhat shorter prickles. The specimens from the Arnold Arboretum from Muskau, which lack the fruits, are more densely pubescent than the other specimens and very like the pubescent form of the southern variety, but the foliage is that of the northern form.

Though the American Beech is usually considered a very homogenous species, the comparison of a large amount of material from the whole range of the species shows that this is not the case and that some authors, particularly the younger Michaux, have shown a very good judgment in distinguishing a northern and a southern Beech and that furthermore the description by some old authors as Aiton and Willdenow of the leaves as tomentose or pubescent beneath was quite correct as regards the technical meaning of these words and did not refer to the silky hairs of the young leaves. My attention was first drawn to these variations when I found several years ago a pubescent form in cultivation in Germany. As I recently consulted the Gray Herbarium with the intention to pursue the matter further, I learned from Professor Fernald that he also had made investigations in this respect, the results of which proved almost identical with the conclusions I had reached.

The distinction of the two geographical varieties with pubescent and glabrous forms presents no difficulties, but the nomenclature seems somewhat complicated. During the nomenclatural unrest of the two last decades the names *F. americana*, *F. atropunicea*, and *F. latifolia*, combinations based on older trinomials, had been substituted for the well known *F. ferruginea* by various American authors, but according to the Vienna rules the oldest binomial available is *F. grandifolia* of Ehrhart, which is one year older than Aiton's *F. ferruginea.* By this nomenclatorial change we avoid the rather awkward situation that a very rare form should constitute the type of this widely distributed American tree, for *F. ferruginea* Aiton is apparently based on one of the hitherto almost unknown pubescent forms of the Beech. This is shown by the description "foliis subtus tomentosis" in Hortus

Kewensis and still more conclusively by the manuscript of Solander for Aiton's Hortus Kewensis, where the habitat is quoted as "Habitat in Marylandia, Jones, in Pennsylvania Math. Hultgren." The specimen collected by Math. Hultgren in Pennsylvania in 1781 is still in the herbarium of the British Museum and has according to Mr. E. G. Baker, to whom we are indebted for a copy of the manuscript description and a tracing of the specimen, the leaves densely and softly pubescent beneath. From the published description however, it seems as if the species were based on Lee's cultivated plant. Ehrhart's *F. grandifolia* represents apparently the northern form. It was described from cultivated plants and Münchhausen's *F. americana latifolia* and Duroi's *F. sylvatica c. americana latifolia* based also on cultivated plants quoted as synonyms; these were probably of the same origin as Lee's plant, which is, according to Loudon's description and the figure of his *F. ferruginea* var. *latifolia,* the northern form and also according to a specimen in the herbarium of the Arnold Arboretum collected at Kew and labeled *F. ferruginea* var. *latifolia* (C. Lee & Son). The *F. Americana latifolia* of Wangenheim also represents the northern form. Thus the name *F. grandifolia* Ehrh. remains with the northern variety as the type and for the southern variety the first available varietal name is *F. ferruginea* var. *caroliniana* of Loudon. The synonymy and the description of the varieties and forms to be distinguished may be appended here.

FAGUS GRANDIFOLIA Ehrhart, Beytr. Naturk. **3**: 22 (1788).— *F. Americana latifolia* Muenchhausen, Hausv. **5**: 162 (1770); Wangenheim, Beytr. Forstwiss. 80, pl. 29, fig. 55, (1787).— *F. sylvatica* c. *Americana latifolia* Duroi, Harbk. Baumz. **1**: 269 (1771).— *F. sylvatica atropunicea* Marshall, Arbust. Am. 22 (1785).— *F. sylvatica* Schoepf, Mat. Med. Am. 140 (1787), not Linné.— *F. ferruginea* Aiton, Hort. Kew. **3**: 362 (1789); F. A. Michaux, Hist. Arb. Am. **2**: 174, pl. 9. (1812); Rafinesque, New Fl. **3**: 80 (1836).— *F. sylvestris,* A. Michaux, Flor. Bor. Am. **2**: 194 (1803).— *F. sylvatica β americana,* Nuttall, Gen. 2: 216 (1818); Emerson, Trees Mass. ed. 2. 180, pl. (1875).— *F. Americana* Sweet, Hort. Brit. 370 (1826); Sargent, Sylv. N. Am. **9**: 27, pl. 444 (1896).— *F. ferruginea* var. *latifolia* Loudon, Arb. Frut. Brit. **3**: 1980. fig. 1916 (1838).— *F. atropunicea* Sudworth, Bull. Torr. Bot. Club. **20**: 42 (1893).— *F. latifolia* Sudworth, Nomencl. Arb. Fl. U. S. 148 (1897).

The type of the species is characterized by the long and slender

prickles, sometimes nearly 1 cm. long, of the usually ashy gray or yellowish tomentose involucre, by the thinner texture and more yellowish green color of the distinctly serrate leaves which are usually cuneate at the base. Of the synonyms quoted above only *F. ferruginea* of Michaux and of Rafinesque and *F. ferruginea latifolia* Loudon refer to this variety as distinguished expressly from the southern variety. It is distributed from Nova Scotia to Ontario and Minnesota and in the mountains as far south as Virginia.

Formá *pubescens* is described above.

Var. **caroliniana** Fernald & Rehder, comb. nov.— *F. sylvatica* Walter, Fl. Carol. 233 (1788).— *F. sylvestris* F. A. Michaux, Hist. Arb. Am. **2**: 170, pl. 8. (1812).— *F. rotundifolia* Rafinesque, Atlant. Jour. 177. (1833).— *F. alba* Rafinesque, New. Flor. **3**: 80 (1836).— *F. heterophylla* Rafinesque, l. c.— *F. nigra* Rafinesque l. c.— *F. ferruginea* var. *caroliniana* Loudon, Arb. Frut. Brit. **3**: 1980 fig. 1915 (1838).—*F. ferruginea* Chapman, Fl. S. U. S. 425 (1860).—*F. americana* Small, Fl. S. E. U. S. 347 (1903).

Differs from the type in the shorter and fewer prickles of the densely rufous-tomentose involucre; and the generally smaller fruits not exceeding the involucre, the broader usually only denticulate leaves, often subcordate at the base, at maturity of firmer texture and of a dull dark bluish green color. The characteristic differences in the fruit between the northern and the southern variety are well brought out by the figures of Michaux; and Rafinesque's description of his *F. ferruginea* as having the "female flowers with many linear smooth bracts" shows that he, too, noticed this character. Distributed from New Jersey to Florida and west to southern Illinois, Missouri and Texas. In the border regions of the range of the northern and southern variety intermediate forms are often found and even in southern New England trees approaching the southern variety occur.

forma **mollis** Fernald & Rehder, f. n.—

Differt a varietate *caroliniana* foliis subtus tota facie dense et molliter pubescentibus.

Differs from the variety *caroliniana* by the densely and softly pubescent under side of the leaves.

Florida: Tallahassee, Leon County, Aug. 7–9, 1895 *Geo. V. Nash* (No. 2339). Louisiana: New Orleans, 1832, *Drummond* (no. 318).

The type specimen from Florida has ovate or oval, denticulate

leaves distinctly subcordate at the base, while Drummond's specimen has elliptic-oblong leaves, cuneate at the base, and has no fruits, but from its range it apparently belongs to the southern and not to the northern variety. Whether the type of *F. ferruginea* from Pennsylvania is to be referred to f. *pubescens* or to f. *mollis* which seems more probable, must remain doubtful as long as we do not know the fruits.

RHUS TYPHINA L. forma LACINIATA Wood, Am. Bot. Flor. pt. 4: 73. (1870) as var.; Flor. Atlant. 73 (1879).

Differs from the type by the irregularly incisely dentate or incisely lobed leaflets which are ovate-oblong to lanceolate and by the leafy panicles. New Hampshire, near Hanover, 1846, *Dr. Rickau* (erroneously spelled Ricard by Wood). (Herb. Gray.)

Rhus typhina L. forma **dissecta**, nom. n.— *R. typhina* var. *laciniata* Hort. [Manning] ex Rehder, Möller's Deutsch. Gärtner-Zeit. **15**: 211. fig. (1900); Hort. ex Cowell; Bailey's Cycl. Am. Hort. **4**: 1530 (1902). —*R. hirta* var. *laciniata* C. K. Schneider, Ill. Handb. Laubholzk. **2**: 154 (1907).

Differs from the type by the bipinnately divided leaves with the leaflets of the second order linear to linear-lanceolate and entire or dentate or sometimes even pinnatifid.

MASSACHUSETTS, locality unknown; found about 15 years ago by J. W. Manning of Reading, Mass. and transplanted into his garden.

A very striking form on account of the graceful feathery appearance of the large (30–45 cm. long) finely dissected leaves. Its ornamental qualities have won for it a place in many American and European gardens particularly in more northern latitudes where the similar but more tender *R. glabra* var. *laciniata* Carr. is not hardy enough.

A few words may be said on the specific name which this species of Rhus has to bear. In 1892 Sudworth (Bull. Torr. Bot. Club **19**: 81) proposed for it the new combination *R. hirta* (L.), because Linné, prior to the publication of his *Rhus typhina* (Cent. Plant. **2**: 14. 1756; Amoen. Acad. **4**: 311. 1760) had named the same species *Datisca hirta* (Spec. Plant. **2**: 103. 1753) from an abnormal specimen with the inflorescence reverting into leaves and with partly confluent leaflets (see also Britton, Bull. Torr. Bot. Club **18**: 269). This explains his placing the plant into an entirely wrong genus. The name *R. hirta*, however, cannot be admitted, according to art. 51, 3 of the Vienna rules of nomenclature, as it is based on a monstrosity.

Acer rubrum L. var. tridens Wood, Class Book Bot. 286. (1860); Am. Bot. Flor. pt. 4: 74. (1870); Flor. Atlant. 24. (1879); Sargent, Sylva N. Am. **13**: 11, pl. 626 (1902).— *A. rubrum* var. β Torrey & Gray, Flor. N. Am. 1: 249 (1838).— *A. microphyllum* Pax, Bot. Jahrb. 7: 180 (1886).— *A. semiorbiculatum* Pax. l. c. 181.— *A. rubrum* subsp. *microphyllum* Wesmael, Bull. Soc. Bot. Belg. **29** : 29 (1890); Schwerin, Gartenfl. **42**: 166 (1893) as forma — *A. rubrum* subspec. *microphyllum* Wesmael, l. c.; Schwerin, l. c. fig. 38, as forma; Pax, Engler's Pflanzenreich IV. 163 : 38 (1902) as forma — *A. tomentosum* Pax, Engler's Pflanzenreich IV. 163 : 38 (1902), not Desfontaines[1] and excl. syn. Marshall[2] and Kirchner.[3]

Differs from the type by having smaller leaves usually only 4 to 8 cm. long and obovate in outline, three-lobed at the apex and narrowed from below the middle into the rounded base, usually very glaucous beneath and with long-persistent pubescence, and thick and firm at maturity. The flowers are sometimes yellow and the fruits usually smaller.

Massachusetts: near Auburndale, May 17, 1904, *M. L. Fernald & Alfred Rehder.* Only one rather large tree was found. This is the most northern locality yet observed for the variety whose range extends south along the Atlantic coast through Florida into eastern Texas.

In its characteristic form the variety appears well marked, but intermediate states are often met with and three-lobed leaves are occasionally found on trees of the typical form and particularly on stunted trees growing in swamps. In the south occurs a still more

[1] The quotation Desfontaines, Tabl. École. Bot. ed. 3 (1829) 136 as given by Pax and also in the Index Kewensis is incorrect; the name without any description appears only in edition 1 (1804) p. 136; in the second and third edition this name and likewise the preceding name *A. coccineum* is omitted and for these two names *A. eriocarpum* Michaux substituted. From this it may be inferred that Desfontaines intended the name *tomentosum* for *A. saccharinum*, but even if an herbarium specimen should still exist and should represent the variety *tridens*, the name cannot be revived as it is indisputably a nomen nudum.

[2] The quotation of Marshall's *A. glaucum* as a synonym of *A. tomentosum* appears to be hardly more than a guess, for Marshall's very vague description does not even clearly show whether he had *A. rubrum* or *A. saccharinum* in mind.

[3] As Kirchner in his short description of *Acer rubrum* var. *tomentosum* (Arb. Muscav. 186. 1864) does not mention the most obvious character, the three-lobed leaves, and as also Count Schwerin, who made a most careful study of the cultivated Maples, describes and figures it as a variety with deeply five-lobed leaves (Gartenfl. **42**: 165 fig. 50. 1893) chiefly distinguished by the persistent pubescence of the under side of the leaves and the intensely red flowers, I do not think it advisable to consider Kirchner's name as a synonym of var. *tridens*.

extreme form in which the two lateral lobes are reduced to large teeth, so that the leaves appear undivided and only coarsely dentate and are then ovate to ovate-oblong in shape. To this form belong the following two specimens: FLORIDA, *Chapman* (herb. Gray) and MISSISSIPPI, Enterprise May 6, 1880 (herb. Arnold Arboretum). Considering the sporadic distribution of the variety *tridens* through the range of the species and the inconstancy of its characters as is clearly shown by a large number of specimens, one cannot consent to its elevation to specific rank, as was done by Pax, who in his earlier monograph distinguished even two species, *A. microphyllum* with smaller leaves very glaucous beneath and with the petiole shorter than the limb and *A. semiorbiculatum* with larger leaves, green (!) beneath and with the petiole longer than the limb, each species based apparently on a single specimen, collected by Kinn in "Am. bor." without indication of the locality. In his later monograph he reduces the latter species to a form of *A. rubrum* and substitutes for *A. microphyllum* the name *A. tomentosum*.

ARNOLD ARBORETUM.

THE FLORA OF THE GREAT SWAMP OF RHODE ISLAND.

ERNEST SHAW REYNOLDS.

THE Great Swamp of Rhode Island is a region which has long been recognized by botanists as offering a very rich collecting ground, and has often been visited by students of botany. The swamp is located in the southern part of the state, in Washington County, close to the junction of the town lines of Charlestown, Richmond, and South Kingstown. The larger part lies in South Kingstown, though a part of the western half is in the adjoining town of Richmond. It is entirely enclosed between the parallels 41° 25′ and 41° 30′ while the meridian 71° 35′ cuts the swamp area into two nearly equal portions. Excluding the part south of Worden's Pond, the swamp area covers about six square miles, which is the largest tract of land in Rhode Island bearing a swamp flora.

There are, in Washington County, at least fifty large and small swamps, and many more lakes and ponds. A large number of these are located in the glacial drift, which covers large areas in the state, and their origin can undoubtedly be traced to the glacial period. The topographical features surrounding the Great Swamp are especially favorable to the development of a swamp. West and northwest of the region, the land is well elevated above the level of Narragansett Bay, and the soil, Gloucester stony loam,[1] is porous and easily drained. The soil north and east of the swamp is of glacial origin and the land also well elevated. To the south there is a combination of soils, some of glacial origin, and some derived from the country rock. The elevations here are not so marked as on the other sides. The swamp itself, therefore, is in a basin at least a hundred feet lower than the surrounding country, and often more. Within the Great Swamp area there are two hills, a little over one hundred and fifty feet in height, which partly traverse the swamp in a north and south direction, thus offering a ready means of entering the area. On the southern edge is Worden's Pond ninety four feet above sea level and at no point more than a few feet deep. Its total length is not over two miles, and it is a little less than a mile and a quarter wide. Passing through the swamp, and entering the pond from the north are two streams, the larger called the Chipuxet River. Cutting the western half into two nearly equal divisions and serving as a boundary between the towns of South Kingstown and Richmond, is the Usquepaugh River, which eventually empties into the Pawcatuck River. Swampy land extends on both sides of these rivers for a mile and a half north of the Great Swamp proper.

The records of former botanical work done in this area are rather scattered and difficult to obtain. The most valuable data of course, are from the collections of Olney and Bennett which are largely in the Brown University Herbarium. Besides these there are scattered specimens from the collections of George Hunt, W. W. Bailey, J. W. Congdon and George A. Leland, all of whom have made trips into the swamp at rare intervals. There is no systematic record so far as known to me, of the flora of the Great Swamp region, and only occasional reference is made to it in Bennett's list of Rhode Island Plants, when he includes it in his reference to "South Kingstown." In two of Mr.

[1] See *Soil Survey of R. I.* by F. E. Bonsteel and E. P. Carr, Washington, 1905.

Olney's field note-books which are now in the possession of the Brown University Herbarium, there are notes of three trips into the swamp. These are recorded as occurring in 1846 and 1847. Without doubt other trips were made, but no more records were found. There are none of Mr. Bennett's notes accessible except his list already mentioned. In a letter recently received from the Hon. J. W. Congdon of Seattle, Washington, who formerly collected extensively in the swamp region, there are some interesting notes of his recollections of the area. Most of the plants he mentions were collected also by the writer last summer. He speaks of the relative abundance of *Habenaria ciliaris* and *H. blephariglottis* as well as of *Gaylussacia dumosa.* Besides these he gives a list of the Utricularias he has found there, namely *Utricularia biflora, clandestina, gibba, cornuta, resupinata,* and *subulata.* Growing in the muddy part of Worden's Pond were *Orontium aquaticum Lachnanthes capitata, Xyris caroliniana, Sabbatia chloroides, Lobelia Dortmanna, Juncus militaris, Rhynchospora macrostachya,* and *R. fusca.* Mr. Leland has also kindly furnished me with a list of a few plants which he has from that area: — *Linum usitatissimum, Utricularia intermedia, U. inflata, Polygonum acre, P. dumetorum* var. *scandens, P. Careyi, P. hydropiperoides, Vaccinium pallidum,* and *V. atrococcum.*

During the latter part of August, 1906, the writer was able to make eight trips into the swamp from different directions as briefly indicated below: —

1. The marshy land on the west side of the Chipuxet River about a half a mile south of the Narragansett Pier R. R.

2. The corresponding swamp east of the Chipuxet near Larkin's pond.

3. The swamp between the Shickasheen River and the N. Y. N. H. & H. track, for a couple of miles south of the Kingstown station.

4. A similar region west of the Shickasheen River.

5. The portion of the swamp lying between the two hills already mentioned.

6. A strip of swamp land including the Fighting Ground and south of that to the Shickasheen River.

7. The northeast corner of Worden's Pond, and the swamp near by.

8. Portions of the pond itself and of the eastern shore.

It is difficult to determine the exact distribution of plants in an area

which, like the Great Swamp, is largely at the same level throughout. Thus the one hundred foot contour line marks in general the strictly swampy area, and Worden's Pond, which drains the swamp, is only ninety four feet above sea level, so that there is a dip of less than ten feet from north to south. There are, however, certain features which aid us in the matter. There are at least two important streams which pass through the swamp, the Chipuxet river, and the Shickasheen immediately west of the main railroad. This gives two different types of water areas viz. running and semi-stagnant, which of course merge imperceptibly into one another. A third type includes the two ponds, Worden's and Larkin's, which have a flora different in certain ways from either of the other two types. The temperature of the water was noticeably warmer in the swamp than along the river courses. Certain plants, though included in the swamp area, show a decided tendency to seek the drier portions, such as *Lespedeza frutescens* and *Rhexia Virginica*. The latter of these seemed to grow more luxuriantly, as a rule, in the wetter situations though the individuals were markedly fewer in number than in drier places. On the other hand many plants were decidedly attracted to the free water courses. A few such plants were *Lobelia cardinalis*, *Lycopus Virginicus* and notably *Bidens laevis*. The latter grew so abundantly along the streams of colder water that its dark foliage clearly marked them. The majority of the plants grow between the higher land and the rivers, seeming to prefer the open sunny places. The Droseras are in the less soggy parts and grow oftentimes on the dead *Sphagnum*. *Sarracenia purpurea*, *Xyris caroliniana* and *X. flexuosa* as well as a host of others inhabit these localities.

It is an interesting matter to find that, even in this formation, which is usually supposed to be especially favorable to monocotyledonous plants, aside from *Carex* the number of species is only about a third of the total number of Phanerogams found in the swamp. Hence even in the most favorable locations the Monocotyledons are outnumbered more than two to one. A large part of the swamp is heavily wooded. This is especially true of the area included between the Chipuxet River and the easternmost hill already mentioned. Here the deciduous trees predominate, though there are several groves of evergreens also. *Rhododendron maximum* grows in great luxuriance in this portion of the swamp.

In the following list of plants collected in the Great Swamp during

August, 1906, no name has been admitted if an authentic specimen was found in any of the Rhode Island Herbaria examined. Hence only about half of the plants collected are here recorded. A specimen of each species is in the writer's herbarium, and duplicates of the majority are also in the Brown University Herbarium.

Plants Not Hitherto Recorded in the Great Swamp Flora.

Dryopteris noveboracensis (L.) Gray.
" *simulata* Davenp.
" *spinulosa* (Retz.) Kuntze.
" *Thelypteris* (L.) Gray.
Lycopodium complanatum L.
" *lucidulum* Michx.
" *obscurum* L.
Sparganium americanum Nutt.
Sagittaria Engelmanniana J. G. Smith.
" *latifolia* Willd.
Calamagrostis cinnoides (Muhl.) Scribn.
Glyceria canadensis (Michx.) Trin.
" *obtusa* (Muhl.) Kuntze.
Dulichium arundinaceum (L.) Britton.
Eriophorum virginicum L.
Fimbristylis capillaris (L.) Gray.
Arisaema triphyllum (L.) Torr.
Xyris flexuosa Muhl.
Eriocaulon septangulare L.
Pontederia cordata L.
" " var. *lancifolia* Morong.
Juncus brevicaudatus (Engelm.) Fernald.
Juncus canadensis J. Gay.
" *marginatus* Rostk.
" *pelocarpus* E. Mey.
" *tenuis* Willd. var. *Williamsii* Fernald.
Medeola virginiana L.
Trillium cernuum L.
" *undulatum* Willd.
Hypoxis erecta L.
Cypripedium acaule Ait.
Habenaria blephariglottis (Willd.) Torr.
" *clavellata* (Michx.) Spreng.
" *psycodes* (L.) Gray.
Spiranthes gracilis (Bigel.) Beck.
Goodyera pubescens (Willd.) R. Br.
Myrica asplenifolia L.
Boehmeria cylindrica (L.) Willd.
Polygonum arifolium L.
" *pennsylvanicum* L.
" *Persicaria* L.
" *sagittatum* L.
" *punctatum* Ell.
Lychnis alba Mill.
Spergula arvensis L.
Nymphaea odorata Dryand.
Nuphar advena (Soland.) R. Br.
Coptis trifolia (L.) Salisb.
Drosera intermedia Haynes.
" *rotundifolia* L.
Baptisia tinctoria (L.) R. Br.
Medicago sativa L.
Trifolium hybridum L.
Desmodium canadense DC.
" *ciliare* (Muhl.) DC.
" *paniculatum* (L.) DC.
" *rigidum* DC.
Lespedeza capitata Michx.
" *frutescens* (L.) Britton.
Oxalis corniculata L.
Polygala Nuttallii T. & G.
" *polygama* Walt.
Euphorbia maculata L.
Rhus copallina L.
Hypericum boreale (Britton) Bicknell.
" *canadense* L.
" *gentianoides* (L.) BSP.
" *maculatum* Walt.
" *virginicum* L.
Viola pedata L.
Chamaenerium angustifolium (L.) Scop.

Oenothera biennis L.
Kneiffia pumila (L.) Spach.
Aralia hispida Vent.
Cicuta bulbifera L.
" *maculata* L.
Sium cicutaefolium Gmel.
Cornus Amonum Mill.
Clethra alnifolia L.
Chimaphila umbellata (L.) Nutt.
" *maculata* (L.) Pursh.
Rhododendron nudiflorum (L.) Torr.
Kalmia latifolia L.
Lysimachia quadrifolia L.
Bartonia virginica (L.) BSP.
Asclepias pulchra Ehrh.
Verbena hastata L.
Scutellaria lateriflora L.
Brunella vulgaris L.
Koellia virginiana (L.) Mac M.
Lycopus americanus Muhl.
" *virginicus* L.
Mentha arvensis L.
Ilysanthes attenuata (Muhl.) Small.
" *gratioloides* (L.) Benth.
Gerardia paupercula (Gray) Britton.
" *purpurea* L.
Plantago aristata Michx.
Cephalanthus occidentalis L.
Galium asprellum Michx.
Viburnum cassinoides L.
" *dentatum* L.
Campanula aparinoides Pursh.
Lobelia cardinalis L.
" *inflata* L.
Vernonia noveboracensis (L.) Willd.
Chrysopsis falcata (Pursh) Ell.
Solidago odora Ait.
" *puberula* Nutt.
" *ulignosa* Nutt.
Anaphalis margaritacea (L.) B. & H.
Leontodon autumnale L.
Hieracium Gronovii L.
" *scabrum* Michx.

Providence, Rhode Island.

THE RETROGRADE COLOR VARIETIES OF GRATIOLA AUREA.

Harley Harris Bartlett.

At Winter Pond in Winchester, Massachusetts, occurs one of the most typical examples of what Blankinship designates in his "Plant-formations of Eastern Massachusetts" as the "Sand-Pond Margin Formation." Its flora is here unusually well developed, containing in addition to the plants enumerated by Blankinship about twenty others, equally characteristic of the formation. One of these, *Gratiola aurea* Muhl., occupies considerable areas of the low, gravelly shore, frequently to the almost complete exclusion of other plants. It occurs here not only in its typical golden-yellow-flowered form, but also in two well marked color forms the flowers of which are respectively honey-yellow and white.

Two published references to these forms have been found, the earlier of them, in John Robinson's "Flora of Essex County, Massachusetts," to the effect that "There is a white variety of this species which grows in Bowler Swamp, Lynn," the other, in Dame and Collins's "Flora of Middlesex County, Massachusetts," to the effect that "The white variety has been found at Winchester by W. H. Manning; both the white and light yellow varieties at Westfield, by Dr. Swan." In the Gray Herbarium there is a sheet of specimens collected by Dr. Swan in a swamp near Lowell, Mass., on which is written, in Dr. Gray's hand,— "Gratiola aurea vars. Ordinary golden-yellow. Pale yellow! White-flowered! in small quantity."

The two forms, as observed at Winter Pond, are absolutely distinct, without intermediates linking them either to the parent form or to each other. They occur in pure colonies, several of which have been under observation for three years, during which time they have been visited at various dates between July 1st and Sept. 15th, an interval which practically covers the flowering period of the species. Never has the honey-colored form been found in a white colony, nor vice versa, although this might be expected to happen occasionally through the casualties of seed dispersal.

The forms may be named: **Gratiola aurea** f. **helveola** f. nov. a forma typica recedit floribus albogilvis, corollae limbo quam tubo pallidiore. — Type (in Herb. Gray) collected by *Dr. C. W. Swan* at a swamp near Lowell, Mass. **Gratiola aurea** f. **leucantha** f. nov. a forma typica floribus clare albis differt.— Type (in Herb. Gray) *Bartlett 820*, Winter Pond, Winchester, Mass., 7 July 1907.

The significance of these forms (retrograde varieties of de Vries) as throwing light upon the origin of specific distinctions is clear at once when the flower-color of the other American species of § *Gratiolaria* is examined. (The often purple-flowered § *Sophronanthe* may be left out of consideration on the ground of its great habital diversity.) We find: I) Species with golden-yellow flowers,— *G. aurea* Muhl., *G. Torreyi* Small and *G. pusilla* Torr. II) Species with flowers merely yellowish, the limb often white or whitish,— *G. gracilis* Benth., *G. floridana* Nutt., *G. virginiana* L., *G. viscosa* Schwein., *G. Drummondii* Benth. *G. ramosa* Walt. and *G. ebracteata* Benth. III) Species with white flowers,— *G. sphaerocarpa* Ell. and *G. macrantha* Chapm.

F. *helveola* corresponds to the second section in the above grouping, f. *leucantha* to the third. The golden-yellow color of the first group

is the resultant of two yellow elements, by the loss of which, either together or singly, retrogression may take place.

Meeting of the Josselyn Botanical Society.— The thirteenth field meeting of the Josselyn Botanical Society of Maine was held at Oxford, Maine, from July 1st to 6th. Owing to various circumstances, there was a very small attendance, but those present found ample material to reward their efforts. The localities of especial interest were the low woods and sandy plains surrounding Whitney Pond, the rocky wooded shores of Thompson Lake, and the extensive arbor-vitae swamps in the town of Norway. The local botanists were very kind in pointing out localities of special interest; Mr. George R. Howe of Norway placing on exhibition his large collection of gems, insects, and other objects of natural history, as well as guiding the party on the trip to the Norway bogs. Mr. W. L. Bacon showed a large collection of the ferns of the region, including many of more than local interest.

A list of all the flowering plants and ferns seen or collected has been kept, and will be published later; the following list, therefore, represents only the plants of unusual interest. On the sand-plain near Whitney Pond large patches of *Lupinus perennis*, L., were found with *Corylus Americana*, Walt. and *Convolvulus spithamaeus* L. This is the first undoubted station for the Lupine in Maine, the record previously depending upon a report in the first edition of the Portland Catalog, (1868). Stations for *Aspidium cristatum clintonianum*, D. C. E., *Habenaria blephariglottis*, Torr., *Medicago denticulata* Willd., and *Erodium cicutarium*, L'Her., were found in Oxford; on the Norway trip, *Cystopteris bulbifera*, Bernh., *Cypripedium spectabile*, Salisb., *Habenaria hyperborea*, R. Br., and *Arceuthobium pusillum*, Peck. were found in abundance. The Dwarf Mistletoe was also found in a bog in Casco, Cumberland Co., with *Woodwardia Virginica*, Smith, and two plants of *Habenaria macrophylla*, Goldie, were secured in Otisfield.— Edward B. Chamberlain, Cumberland Center, Maine.

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A PARTIAL LIST OF CONNECTICUT DIATOMS WITH SOME ACCOUNT OF THEIR DISTRIBUTION IN CERTAIN PARTS OF THE STATE.

William A. Terry.

Connecticut is rich in diatoms, both in quantity and variety, and fossil deposits are abundant, both of fresh water and marine. The very ancient deposits like those of Virginia and Maryland cannot be expected here, as the great ice sheet during glacial times swept all such as may have existed into the sea, but the time since then has been sufficient for the accumulation of a vast store of material of which very little has ever been investigated. I have found eleven fresh water deposits in Bristol, varying in size from a few rods in diameter to many acres; one in the northern part of the town, "No. 11," covers fifteen acres and possibly much more. The diatomaceous stratum of these deposits is generally three to four feet below the surface, and in the larger deposits averages about two feet in depth, but in No. 11 it is of unknown depth; I have material from ten and a half feet below the surface, showing about seven feet of diatoms to this point; it is especially interesting as it contains numbers of the beautiful *Cyclotella antiqua* W. Sm., which is very rare in this country; all correspondents to whom I have sent it report that they had never seen it before. Dr. Ward sent me a slide with this label from Prof. H. L. Smith's collection which is in his possession, but the forms shown were not the same. The specimens from which Van Heurck made his drawings for his Synopsis must have been very inferior to the Bristol specimens in beauty.

In New Britain Mr. W. R. Stone discovered a fossil deposit in which I found a new *Stauroneis*, the outline of which resembled that of

Navicula amphirhyncus Ehrenb., but exhibited an oblique stauros. This might appropriately have been called *obliqua*, but as Gregory had appropriated this name for an entirely different and much smaller form, I named it *S. nova britannica*, and it was so published in Dr. Bigelow's Observer. Gregory's form was not strictly a *Stauroneis*; it was a very small stauroneiform *Scoliopleura*, and its stauros was not oblique. This New Britain *Stauroneis* is the most rare species of which I have any knowledge; Mr. Stone's original gathering contained some hundreds, perhaps thousands of specimens, but on subsequent investigation no more could be found; they were probably confined to a very thin stratum of the deposit which was not identified, and further exploration is difficult if not impossible as the ground is covered with buildings.

Connecticut waters also are rich in living diatoms, and recent deposits abound. Nearly every lake and pond has its bottom covered with a soft ooze, which is filled with diatoms and is often two or more feet in thickness. The margins of rivers, ditches in the marshes, and the bottoms of small streams and rills in springy mountain pastures, furnish them in abundance. A small stream in a marshy pasture on Fall Mountain in Bristol has an abundant colony of the large variety of *Stauroneis acuta* W. Sm., many times larger than the type of Wm. Smith. I have a slide sent me by Prof. H. L. Smith which he assured me was part of the original gathering from which Tuffen West made the drawing of *S. acuta* for Smith's British Diatomaceae; this is the same as the *Pleurotaenium acutum* of other authors, and is distinctly different from the large Bristol *Stauroneis*. In the colony I find another *Stauroneis* which is quite remarkable; it is longer and more cylindrical than the other species, has a broad stauros and rounded ends with a large saucer-shaped pseudonodule near each end of the upper valve but none on the lower valve. Next to the New Britain *Stauroneis* this is the most rare of all our species of diatoms. They may be gathered in hundreds from a space of about thirty feet on this brook, but they are so much outnumbered by other species with them that it is difficult to find them after they are collected; I have found a single specimen in each of three widely separated ponds in Bristol, but they are known nowhere else. Dr. Ward named this species *Stauroneis Terryi*. In another small stream on Fall Mountain, Mr. W. C. Richards found a colony of *Navicula elliptica* Kütz., notable for abundance and size of individuals.

In five different ponds in Bristol I have found an abundance of a new *Surirella,* and in one of these ponds it is the predominating form. It is about the size of *S. gracilis* A. Schm., but not so alate, and with rounded ends, costa distinct, reaching the median line, which is strongly marked; most specimens have a slight spiral twist. It occurs in two types, one greatly elongated. The living frustules are sometimes covered with coarse granulations that do not come off in the acid treatment, but are removed by the soda. Prof. H. L. Smith wrote me "This *Surirella* is certainly new and much more deserving of a specific name than many others." Dr. Ward named it *Surirella Terryi.* I have found this species abundant in one small pond in New Britain and in one at Leete's Island, but in all other localities known to me it is extremely rare. In Birge's Pond in Bristol are countless numbers of a very peculiar abnormal form of *Surirella.* It is a double frustule in which the two inner valves are grown together with a perforation through the center where the protoplasm of the two cells joins. This opening is sometimes a mere raphe or cleft, more often it is a long narrow slit with smooth edges, but generally it is a large irregular orifice with corrugated sides. This peculiarity is most abundant in *Surirella elegans* Ehrenb., but frequent in *S. cardinalis* Kitton, and occasional, in *S. splendida* (Ehrenb.) Kütz. I found it first in *S. striatula* Turpin in an artificial culture of material from West River, New Haven. Mr. Richards brought me mud from a pond in Wallingford, in which I found it abundant in *S. saxonica* Auersw.; I have seen it in *S. tenera* Greg. and *S. fastuosa* Ehrenb., and have found it in Plymouth and in Derby. An illustrated description was published in Tempère's Micrographe Préparateur.[1]

Nearly every marsh with a level surface covers a deposit of diatoms, and the salt marshes of the Connecticut shore are no exceptions. All of these that I have examined lie above a marine deposit, which generally appears like clay, but always contains diatoms and is sometimes quite rich. The ancient channel of Leete's Island from Great Harbor on the south around to Shell Beach on the north, is one immense mass of marine deposit, in some places fifty feet thick. When the railroad crossing it was changed from a trestle to an embankment, the pressure of the great bank of earth forced out the marine mud

[1] W. A. Terry, Sur un étrange mode de développement chez le genre Surirella. Le Micrographe Préparateur, Vol. XIII, p. 57, 1905.

below it which rose up in great banks on each side of the railroad. All this material contained diatoms, and some of it was very rich, especially in number and rarity of species. I dug up material from about twelve feet below the surface, and found a stratum rich in the beautiful *Surirella Febigerii* Lewis and other rare kinds. One pound of this earth furnished diatoms enough to make several thousand slides, each slide containing thousands of diatoms. The marine deposit in these marshes is sometimes near the surface, and is thrown out in digging ditches, and always in quantities in preparing the foundations for the abutments of bridges. From the earth thrown out in digging a post-hole for a fence on the margin of the marsh near Branford Station I procured a supply of *Campylodiscus echineis* Ehrenb. The Quinnipiac marshes are large, and along their western margin is a series of clay pits from which the tide water is kept out by dikes. The diatomaceous deposit here is of no great thickness but has a very interesting collection of species. At Davis pit the clay is covered by a layer of sand, upon which rests a stratum of alluvium, which contains fresh water diatoms exclusively; these are mostly decayed and broken, those entire being chiefly *Navicula lata* Bréb., with a few of the large *Stauroneis acuta* and *Navicula Semen* Ehrenb. Upon the alluvium is a mass of loam containing the roots and stumps of trees with their trunks and branches beside them, the whole covered with the marine deposit, which extends upward through about four feet of coarse peat.

At many places along the Connecticut shore the ancient marine deposit projects through the bank of sand forming the beach, and is visible at low tide, the huge bank of sand being a superficial structure cast up by the sea and resting upon the ancient deposit. All these salt marshes were once open water, and the sea is now coming back upon them and swallowing up the land. Some of the pond holes in these marshes are deep, with a bottom of soft mud; these are often the remains of former open water, and are always rich in diatoms, frequently very different from those of the neighboring waters. Here is the home of the large *Pleurosigma balticum*, the very large *Amphiprora pulchra* Bail., the larger type of *Surirella striatula*, *Scoliopleura*, *Amphora*, and a variety of rare forms.

In a pond hole of the marshes of Morris Creek I found a new *Pleurosigma*, quite large, in Morris Creek another, not quite so large. On the rocks near the tide gate were masses of *Melosira Borreri* Grev.,

looking in the water like enormous sponges, but collapsing when gathered into a rope of harsh feeling filament, about two feet long, which held great numbers of other diatoms, among them another new *Pleurosigma,* quite small. I sent all three to Tempère, he passed them on to Peragallo, who published illustrated descriptions of them in his monograph[1] which is now the accepted standard for *Pleurosigma.* Peragallo named the largest one *P. Terryanum,* the second *P. Americanum,* and the third *P. paradoxum.* He describes the first as having the outline of *P. strigilis* W. Sm., but the striation of *P. balticum*; the second having the outline of *P. elongatum* W. Sm., but striation of *P. decorum* W. Sm.; and the third was named *P. paradoxum* because the least approximate of its series of striae was the most difficult to resolve. I afterwards found *P. Terryanum* more abundant and larger in a broad ditch at Quinnipiac, and in a pond at Leete's Island. Its natural habitat is in brackish water fed by fresh water springs and too nearly fresh to support *P. balticum.* With this is often found *P. elongatum,* and also the robust type of *Surirella striatula* and a peculiar variety of *Navicula permagna* (Bail.) Ehrenb. The normal type of *N. permagna* is abundant in Oyster River, Woodmont. The species of *Pleurosigma* are found with it at Leete's Island, and also a remarkable colony of *Navicula maculata* Bail., which occurs here in great abundance, and in three distinct types; the largest is extremely rare elsewhere, the second found occasionally along the Connecticut shore, and the third and smallest is the most common. I have it from the New Jersey shore and from Cuxhaven, North Sea. A much smaller variety but with coarser puncta is found in Alabama. The typical *P. Terryanum* is the largest *Pleurosigma* that I find in Connecticut; *P. Americanum* is abundant in tidal creeks; in the marsh on the West Haven side of West River, on the muddy sloping bank of a ditch, I have seen at low tide a brown film about two feet wide and a hundred feet long, which consisted almost entirely of living frustules of *P. Americanum. P. paradoxum* is most abundant in Morris Creek, occasional elsewhere. Morris Creek is also the habitat of *Actinocyclus Barkleyi* (Ehrenb.) Grun., which is living here in abundance. I have it also in considerable numbers from the Thames river above Norwich in material sent me by Mr. G. R. Lumsden of Greenville.

[1] Peragallo, Monographie du genre Pleurosigma. Le Diatomiste, Vol. I.

At Branford I find *Ditylum Brightwellii* (West) Grun.; the drawings in books show this with long central spine with abrupt termination, without finish; the Branford specimens have a longer spine terminating in a knob or ball, which indicates that the specimens from which the figures were made were broken. *Nitzschia scalaris* (Ehrenb.) W. Sm. grows abundantly in the brackish water of many of the pond holes of the salt marshes. Pond's Point at Milford is a rounded projection where the southward trend of the shore changes abruptly to west. The beach is composed of large cobblestones and boulders upon a coarse gravel. On its southern margin is visible at low tide a bank of fossil mud, which is firm enough to resist the action of the waves, and is being gradually uncovered as the mass of stones is driven back by storms. A stratum near the upper part of this bank is very rich in diatoms, showing an unusual combination of marine and brackish water forms of more than one hundred species. *Coscinodiscus, Actinoptychus, Triceratium, Amphitetras, Eupodiscus,* with a dozen species of *Pleurosigma* occur, while the abundance of the brackish water form of *Surirella striatula* and *Navicula permagna,* with *Scoliopleura, Amphora, Amphiprora* and *Nitzschia scalaris* (Ehrenb.) W. Sm. show this mud to have once formed the bottom of a pond hole in the marsh; the fresh water spring that fed it still flows over it, and can be seen at low tide. The pressure of the great bank of stones which rested upon it during the time it was being driven over by the sea has crushed to fragments most of the delicate species, but enough remain to show conclusively its character. The marine species mentioned above can be found generally in deep water all along the Connecticut shore, while the different varieties of *Navicula lyra* Ehrenb. and the *Pleurosigmas* are most abundant in shallow water. I have *P. intermedium* W. Sm. abundant in the deep water of Clinton, and the very rare *Navicula Lewisiana* Grev. in shallow water at Bridgeport. *P. balticum* is the most abundant species of the genus, and has many varieties, the largest being found in the salt marshes, the normal type in coves and bays, and the smallest in deep water. *P. affine* Grun. is the most universally distributed being found everywhere along the shore but not generally in great abundance. It is very often mistaken for *P. angulatum* W. Sm., although striation is very different. *P. angulatum* is frequent but local. A ditch in the Quinnipiac marshes through which flows at low tide a strong stream of nearly fresh water is carpeted with a dense growth of *Biddulphia levis* Ehrenb., and near

this is a colony of large and very active *Bacillaria paradoxa* (Gmel.) Grun. Another colony of this species in Morris Creek marsh, although in constant motion, was covered with a parasitic growth of *Leptothrix,* and was accompanied by numerous rapidly revolving filaments of *Spirulina.*

In fresh water the most abundant genus is *Pinnularia* W. Sm.; it is found in quantities almost everywhere. Next to this in numbers is the genus *Stauroneis,* then *Cymbella, Surirella, Navicula,* and numerous filamentous forms. Although these genera are represented in nearly every pond, yet each pond shows a combination characteristic of itself, and types of the same species vary greatly in the different ponds. In several ponds in Bristol *Surirella elegans* is very large and sometimes much elongated; in Plymouth it is smaller and much shorter in proportion; in Highland Lake, Winsted, beautifully typical specimens of *S. nobilis* W. Sm. are abundant, and in several ponds in Connecticut *Navicula peripunctata* Brun abounds; Prof. Brun founded the species on specimens in mud from Crane Pond, Groveland, Massachusetts, but it is more plentiful in Bristol and in Leete's Island. Van Heurck states that *Achnanthidium flexellum* (Kütz.) Bréb. is rare; it is abundant in two of the Bristol fossil deposits. He also gives *Fragilaria Harrisonii* Grun as very rare; this grows abundantly in Bristol. Dr. Ward found a new diatom in one of my slides from the Connecticut shore, which Cleve named *Caloneis Wardii.* Mr. O. E. Shaffer sent a find of *Nitzschia* to Europe from Port Townsend, Puget Sound, and Cleve named this *N. Shafferi*; I had previously found this nearly twenty years ago at Morris Creek, and reported it at the time in the Amer. Micr. Journal as *N. curvula.* I find *Isthmia nervosa* Kütz. in nearly every deep water sounding from off the Connecticut shore, but do not believe that it grows here; it is probably brought in by ocean currents from warmer waters.

List of Species.

The arrangement of this list is that of De Toni, Sylloge Algarum, and the nomenclature for the most part follows that work. Names given as synonyms are those that have been used by the writer either in published notes or with material distributed. Species marked with a star were founded on Connecticut material.

Navicula nobilis (Ehrenb.) Kütz. Common.

Navicula var. *dactylus* (Ehrenb.) VH. (*N. dactylus* Kütz.) Abundant everywhere.
" *gigas* (Ehrenb.) Kütz. Common.
" *major* Kütz. Abundant everywhere.
" *viridis* (Nitzsch) Kütz. Abundant everywhere.
" *cardinalis* Ehrenb. Frequent, local, Bristol.
" *yarrensis* Grun. Occasional.
" *divergens* (W. Sm.) Ralfs. Frequent, local, Bristol.
" *longa* (Greg.) Ralfs. Frequent.
" *lata* Bréb. Frequent.
" *borealis* (Ehrenb.) Kütz. Frequent, local, Bristol.
" *directa* Ralfs. Occasional.
" *Brebissonii* Kütz. Frequent, local, Bristol.
" *Tabellaria* Kütz. Frequent, local.
" *gibba* (Ehrenb.) Kütz. Frequent, local, Bristol.
" *Legumen* Ehrenb. Occasional.
" *polyonca* Bréb. Frequent.
" *peregrina* (Ehrenb.) Kütz. Common.
" *semen* Ehrenb. Frequent, local, Bristol.
" *zostereti* Grun. Rare, Morris Creek.
" *rhyncocephala* Kütz. Occasional.
" *cancellata* Donk. Frequent, local, Fort Hale.
" *fortis* (Greg.) Grun. Occasional.
" *digito-radiata* (Greg.) Ralfs. Occasional.
" *distans* (W. Sm.) Ralfs. Occasional.
" *brasiliensis* Grun. Frequent.
" *crabro* (Ehrenb.) Kütz. Frequent.
" *interrupta* (Bail.) Kütz. Frequent.
" *didyma* Ehrenb. Common.
" *bombus* (Ehrenb.) Kütz. Occasional.
" *Smithii* Bréb. Frequent.
" *fusca* (Greg.) Ralfs. Frequent.
" *advena* A. Schm. Occasional.
" *elliptica* Kütz. Occasional.
" " var. *oblongella* (Näg.) VH. (*N. oblongella* Näg.) Occasional.
" *lyra* Ehrenb. Locally abundant.
" *pygmaea* Kütz. Local.
" *forcipata* Grev. Occasional, New Haven Harbor.
" *caribaea* Cleve. Occasional, New Haven Harbor.
" *approximata* Grev. Occasional, New Haven Harbor.
" *irrorata* Grev. Occasional.
" *praetexta* Ehrenb. Occasional.
" *Hennedyi* W. Sm. Occasional, Leete's Island.
" *clavata* Greg. Occasional.
" *polysticta* Grev. Occasional, New Haven Harbor.
" *hibernica* O'M. Occasional.

Navicula aspera Ehrenb. Occasional.
" *californica* var. *campeachiana* Grun. Occasional.
" *circumsecta* Grun. Occasional.
" *tuscula* Ehrenb. Rare, local, Bristol.
" *crucicola* (W. Sm.) Donk. Local.
" *palpebralis* Bréb. Occasional.
" *Fischeri* A. Schm. Occasional.
" *arabica* Grun. Occasional.
" *humerosa* Bréb. Frequent.
" *tumescens* Grun. Common.
" *marina* Ralfs. Occasional.
" *pusilla* W. Sm. Local, Quinnipiac.
" *latissima* Greg. Rare.
" *kamorthensis* Grun. Rare, Stony Creek.
" *cuspidata* Kütz. Frequent, local, Bristol.
" *sphaerophora* Kütz. Rare, local, Bristol.
" *serians* (Bréb.) Kütz. Frequent, local, Bristol.
" *formosa* Greg. Frequent.
" *permagna* (Bail.) Edw. Occasional; abundant at Woodmont.
" *elegans* W. Sm. Occasional.
" *limosa* Kütz. Occasional.
" *iridis* Ehrenb. Common.
" " var. *Amphigomphus* (Ehrenb.) VH. (*N. amphigomphus* Ehrenb.) Local.
" " var. *producta* (W. Sm.) VH. (*N. producta* W. Sm.) Occasional.
" " var. *amphirhynchus* (Ehrenb.) De Toni. (*N. amphirhynchus* Ehrenb.) Local.
" *firma* Kütz. Common.
" *Hitchcockii* Ehrenb. Rare, local, Bristol.
" *liber* W. Sm. Occasional.
" *americana* Ehrenb. Rare, local, Bristol.
" *bacillum* Ehrenb. Local.
" *Powellii* Lewis. Occasional.
" *columnaris* Ehrenb. Common.
" *esox* (Ehrenb.) Kütz. Occasional.
" *Sillimanorum* (Ehrenb.) Kütz. Rare, local, Bristol.
" **parallela* Castr. Rare, Bristol.
" *dilatata* Ehrenb. Common.
" *delawarensis* Grun. Local, Quinnipiac.
" *interposita* Lewis. Frequent.
" *amphipleuroides* Grun. Rare.
" *Bartleyana* Grun. Occasional.
" *diploneis* var. *obliquus* Brun. Occasional.
" *maculata* Bail. Occasional; abundant at Leete's Island.
" *peripunctata* Brun. Occasional; abundant in Bristol.

Navicula **theta* Cleve. Local, Quinnipiac.
" **tubulosa* Brun. Occasional.
Caloneis **Wardii* Cleve. Occasional.
Diploneis **didyma* var. *obliqua* Brun. Occasional.
Libellus rhombicus (Greg.) De Toni. (*Navicula rhombica* Greg.)
Rhoiconeis trinodis (W. Sm.) Grev. (*Navicula trinodis* W. Sm.) Rare, Bristol.
Stauroneis phoenicenteron (Nitzsch) Ehrenb. Abundant everywhere.
" *gracilis* W. Sm. Frequent.
" *Gregoryi* Ralfs. Occasional.
" *spicula* Hickie. Rare, Quinnipiac.
" *salina* W. Sm. Common along shore.
" *Stodderi* Lewis. Rare, Bristol.
" **nova britannica* Terry. Rare; only in New Britain.
" **Terryi* Ward. Exceedingly rare; only in Bristol.
Pleurostauron acutum (W. Sm.) Ralfs. (*Stauroneis acuta* W. Sm.) Common.
Pleurosigma angulatum (Quek.) W. Sm. Frequent, local.
" " var. *aestuarii* (Bréb.) VH. Occasional.
" *elongatum* W. Sm. Frequent.
" " var. *gracile* Grun. Occasional.
" *strigosum* W. Sm. Rare, Clinton.
" *naviculaceum* Bréb. Rare.
" *intermedium* W. Sm. Rare, Clinton.
" *nubecula* W. Sm. Rare, Clinton,
" *latum* Cleve. Rare.
" *formosum* W. Sm. Occasional.
" *hypocampus* W. Sm. Frequent, local.
" *decorum* W. Sm. Locally abundant.
" *littorale* W. Sm. Rather rare.
" *balticum* (Ehrenb.) W. Sm. Frequent, local.
" *simile* Grun. Rare, Leete's Island.
" *attenuatum* W. Sm. Frequent, local.
" *Wansbeckii* Donk. Frequent.
" *acuminatum* (Kütz.) Grun. Rather rare.
" *strigile* W. Sm. Occasional.
" *affine* Grun. & Cleve. Common all along the shore.
" **paradoxum* Per. Occasional, Morris Creek.
" *Brebissonii* Grun. & Cleve. Frequent.
" **Terryanum* Per. Local, Quinnipiac, Leete's Island.
" *Spencerii* (Quek.) W. Sm. Frequent, local.
" " var. *curvulum* (Kütz.) Grun. Rare, Quinnipiac.
" *fasciola* W. Sm. Frequent.
" *scalproides* Rab. Rare.
" *eximium* (Thw.) Grun. & Cleve. Occasional.
" **americanum* Per. Abundant, Morris Creek, New Haven.

Pleurosigma subsalinum Per. Rare, Leete's Island, Milford.
Gyrosigma **Temperii* Cleve. Occasional.
Scoliopleura latestriata (Bréb.) Grun. Frequent.
" " *var. *Amphora* Cleve. Rare, Morris Creek.
" *tumida* (Bréb.) Rab. Frequent.
Frustulia rhomboides (Ehrenb.) De Toni. (*Navicula rhomboides* Ehrenb. Frequent.
" " var. *saxonica* (Rab.) De Toni. (*Navicula crassinervia* Bréb.) Occasional.
" *Lewisiana* (Grev.) De Toni. (*Navicula Lewisiana* Grev.) Rare, Bridgeport only.
" *viridula* (Bréb.) De Toni. (*Schizonema viridulum* Rab.) Rare.
Dickiea crucigera (W. Sm.) De Toni. (*Schizonema crucigerum* W. Sm.) Rare, Quinnipiac.
Brebissonia Boeckii (Kütz.)Grun. (*Navicula Boeckii* Bréb.) Occasional; abundant in Thames River.
Mastogloia **gibbosa* Brun. Occasional.
" *undulata* Grun. Occasional.
Amphiprora lepidoptera Greg. Frequent.
" " var. *pusilla* (Greg.) VH. Frequent.
" *maxima* Greg. Locally abundant.
" *alata* Kütz. Frequent.
" *pulchra* Bail. Locally abundant.
" *conspicua* Grev. Frequent.
" *ornata* Bail. Frequent.
Plagiotropis vitrea (W. Sm.) Grun. (*Amphiprora vitrea* W. Sm.) Frequent.
Tropidoneis **seriata* Cleve. Occasional.
" **zebra* Cleve. Occasional.
Cymbella Ehrenbergii Kütz. Locally abundant.
" *cuspidata* Kütz. Frequent.
" *affinis* Kütz. Local, New Britain.
" *heteropleura* (Ehrenb.) Kütz. Local.
" *gastroides* Kütz. Common everywhere.
" *cymbiformis* var. *parva* (W. Sm.)VH. Local, New Britain.
" *americana* A. Schm. Locally abundant.
" *cistula* var. *maculata* (Kütz.) Grun. Local, New Britain.
Encyonema caespitosum Kütz. Frequent.
" *prostratum* (Bail.) Ralfs. Frequent.
Amphora levis Greg. Frequent.
" *cingulata* Cleve. Frequent.
" *erebi* Ehrenb. (*A. cymbifera* Greg.) Frequent.
" *Clevei* A. Schm. Frequent.
" *intersecta* A. Schm. Frequent.
" *Eulensteinii* Grun. Frequent; locally abundant at Milford.
" *proteus* Greg. Frequent.

Amphora obtusa Greg. Frequent.
" *ovalis* (Bréb.) Kütz. Frequent.
Gomphonema acuminatum Ehrenb. Common.
" *constrictum* Ehrenb. Common.
" *capitatum* Ehrenb. Common.
" *geminatum* (Lyng.) Ehrenb. Common.
" *augur* Ehrenb. (*G. cristatum* Ralfs.) Common.
Rhoicosphaenia curvata (Kütz.) Grun.
Cocconeis scutellum Ehrenb. Frequent.
" *dirupta* Greg. Frequent.
Achnanthes longipes Ag. Common.
" *brevipes* Ag. Common.
" *subsessilis* Kütz. Fort Hale.
" **curvirostrum* Brun. Very rare, Morris Cove.
" **manifera* Brun. Very rare, Morris Cove.
Achnanthidium flexellum (Kütz.) Bréb. Rare; abundant in Bristol, fossil.
Bacillaria paradoxa (Gmel.) Grev. Occasional near New Haven.
Nitzschia granulata Grun. Occasional.
" *tryblionella* Hantzsch. Frequent.
" " var. *maxima* Grun. Occasional.
" *plana* W. Sm., Occasional.
" *marginulata* Grun. Occasional.
" *acuminata* (W. Sm.) Grun. Occasional.
" *circumsuta* (Bail.) Grun. Frequent.
" *scalaris* (Ehrenb.) W. Sm. Abundant.
" *angularis* W. Sm. Frequent.
" *sigmoidea* (Nitzsch) W. Sm. Frequent, locally abundant.
" *sigma* (Kütz.) W. Sm. Common.
" *fasciculata* Grun. Common.
" *obtusa* W. Sm. Occasional.
" *linearis* var. *tenuis* (W. Sm.) Grun. (*N. tenuis* W. Sm.) Rare, Leete's Island.
" *curvirostris* var. *Closterium* (Ehrenb.) VH. (*N. Closterium* W. Sm.) Rare, West Haven.
" *Lorenziana* Grun. Rare.
" *Shafferi* Cleve. (*N. curvula* Terry, not W. Sm.) Very rare, Morris Cove.
Hantzschia amphioxys (Ehrenb.) Grun. Abundant in Bristol.
" **segmentalis* Brun. Rare, Morris Cove.
Surirella biseriata (Ehrenb.) Bréb. Common.
" *linearis* W. Sm. Frequent.
" *robusta* Ehrenb. Frequent in Winsted.
" *splendida* (Ehrenb.) Kütz. Common.
" *tenera* Greg. Common.
" *elegans* Ehrenb. Common.
" " var. *norvegica* (Eulen.) Brun. Occasional, Bristol.

Surirella striatula Turp. Frequent, locally abundant.
" " var. *triplicata* Grun. Occasional.
" *gemma* Ehrenb. Frequent.
" *cardinalis* Kitt. Rather rare; abundant in Bristol.
" *ovalis* Bréb. Occasional.
" " var. *angusta* (Kütz.) VH. (*S. angusta* Kütz.) Occasional.
" *fastuosa* Ehrenb. Frequent.
" " var. *lata* (W. Sm.) VH. Frequent.
" *recedens* A. Schm. Occasional.
" *Moelleriana* Grun. Occasional.
" *gracilis* A. Schm. Occasional.
" *Febigerii* Lewis. Frequent.
" *constricta* Ehrenb. Rare, Killingsworth.
" **Terryi* Ward. Rare, except in Bristol, New Britain and Leete's Island.
Cymatopleura elliptica (Bréb.) W. Sm. Rare, New Britain.
" *solea* (Bréb.) W. Sm. Occasional.
" *hibernica* W. Sm. Rare.
" *marina* Lewis. Rare, Clinton.
Podocystis adriatica Kütz. (*P. americana* Bail.) Rare.
Campylodiscus echineis Ehrenb. Common.
" *hibernicus* Ehrenb. Frequent.
Diatoma vulgare Bory. Frequent.
" *elongatum* var. *tenue* (Ag.) VH. (*D. tenue* Ag.) Frequent.
" *hiemale* (Lyngb.) Heib. (*Odontidium hiemale* Kütz.) Locally abundant.
" *anceps* (Ehrenb.) Kirchn. Frequent.
Odontidium mutabile W. Sm. Locally abundant.
" *Harrisonii* W. Sm. (*Fragilaria Harrisonii* Grun.) Rare and local, Bristol.
Meridion circulare (Grev.) Ag. Frequent.
" *intermedium* H. L. Sm. Frequent.
Synedra pulchella (Ralfs) Kütz. Occasional.
" " var. *Smithii* (Ralfs) VH. Occasional.
" *ulna* var. *danica* (Kütz.) VH. (*S. danica* Kütz.) Frequent.
" *affinis* Kütz. Frequent.
Ardissonia superba (Kütz.) Grun. (*Synedra superba* Kütz.) Occasional, Leete's Island.
Asterionella formosa Hass. Abundant in water supply.
" *Ralfsii* W. Sm. Abundant in water supply.
Fragilaria virescens Ralfs. Common.
" *capucina* Desmaz. Common.
" *construens* (Ehrenb.) Grun. Common.
Raphoneis amphiceros Ehrenb. Frequent.
" *belgica* Grun. Rare, Leete's Island.
" " var. *intermedia* Grun. Occasional.
" *gemmifera* Ehrenb. Frequent.

Dimerogramma minus (Greg.) Ralfs.
" *Surirella* (Ehrenb.) Grun. (*Raphoneis Surirella* Grev.) Occasional.
Plagiogramma staurophorum (Greg.) Heib. (*P. Gregorianum* Grev.) Occasional, Quinnipiac.
" *validum* Grev. Occasional, Leete's Island.
Licmophora flabellata (Carm.) Ag. Frequent.
" *Juergensii* Ag. Frequent.
" *tincta* (Ag.) Grun. Frequent.
Tabellaria fenestrata (Lyngb.) Kütz. Common.
" *flocculosa* (Roth) Kütz. Common.
Grammatophora oceanica var. *macilenta* (W. Sm.) Grun.
Rhabdonema arcuatum (Lyngb.) Kütz. Occasional.
" *adriaticum* Kütz. Common.
Epithemia turgida (Ehrenb.) Kütz. Frequent.
" *gibba* (Ehrenb.) Kütz. Occasional.
" " var. *ventricosa* (Ehrenb.) Grun. Frequent.
" *argus* (Ehrenb.) Kütz. Frequent.
" *zebra* (Ehrenb.) Kütz. Frequent.
" *musculus* Kütz. Frequent.
Eunotia major (W. Sm.) Rab. Frequent.
" *praerupta* Ehrenb. Frequent.
" " var. *bidens* Grun. Frequent.
" *gracilis* (Ehrenb.) Rab. Frequent.
" *robusta* Ralfs, including *E. Diadema* Ralfs. Frequent.
" *elongata* Rab. Frequent.
Pseudoeunotia lunaris (Ehrenb.) Grun. (*Eunotia lunaris* Grun.) Locally abundant.
" *flexuosa* (Bréb.) Grun. (*Eunotia flexuosa* Bréb.) Locally abundant.
" *flexuosa* var. *bicapitata* Grun. Locally abundant.
Actinella punctata Lewis. Common.
Rhizosolenia styliformis Brightw. Leete's Island.
Isthmia nervosa Kütz. Frequent.
Hemiaulus affinis Grun. South Haven.
" *tubulosus* Brun. Occasional.
Odontella aurita (Lyng.) Ag. (*Biddulphia aurita* Bréb.) Frequent.
" *turgida* (W. Sm.) VH. Frequent.
Biddulphia pulchella Gray. Frequent.
" *Tuomeyi* (Bail.) Roper. Occasional.
Denticella mobiliensis (Bail.) Grev. (*Biddulphia Baileyi* W. Sm.) Rare.
" *rhombus* Ehrenb. (*Biddulphia rhombus* W. Sm.) Frequent.
Eunotogramma laeve Grun. Occasional.
Terpsinoe musica Ehrenb. Occasional.
" *americana* (Bail.) Ralfs. Occasional.

Amphitetras antediluvianus Ehrenb. Frequent.
Triceratium alternans Bail. Occasional.
" *flavum* Ehrenb. Frequent.
Lithodesmium undulatum Ehrenb. Leete's Island.
Syndendrium diadema Ehrenb. Occasional.
Periptera tetracladia Ehrenb. Occasional.
Pyxilla baltica Grun. Frequent; locally abundant, Leete's Island.
Ditylium Brightwellii (West) Grun. including *D. inaequale* Bail., *D. tetragonum* Bail., and *D. trigonum* Bail. Very rare, Branford only.
" *intricatum* (West) Grun. Very rare, Branford.
Auliscus pruinosus Bail. Frequent.
" *sculptus* (W. Sm.) Ralfs. Common.
" *caelatus* Bail. Occasional.
" *Macraëanus* Grev. Occasional.
Pseudoauliscus radiatus (Bail.) Rattray. Rare, Leete's Island.
Cerataulus levis (Ehrenb.) Ralfs. (*C. polymorphus* VH. *Biddulphia levis* Ehrenb.) Frequent.
Eupodiscus Rodgersii Ehrenb. Rare, Leete's Island.
" *argus* Ehrenb. Frequent.
Stephanopyxis turris (Grev.) Ralfs. Occasional, New Haven.
" " var. *intermedia* Grun. (*S. appendiculata* var. *intermedia* Grun.) Occasional.
" *ferox* (Grev.) Ralfs. Occasional, Milford.
" *corona* (Ehrenb.) Grun. Occasional.
Stephanodiscus niagarae Ehrenb. Rare.
Actinocyclus crassus VH. Frequent.
" *Ralfsii* (W. Sm.) Ralfs. Frequent.
" *Barkleyi* (Ehrenb.) Grun. Abundant, Morris Cove.
" *Ehrenbergii* Ralfs. Frequent.
" *tenuissimus* Cleve. Rare, Morris Cove.
" *subtilis* (Greg.) Ralfs. Rare, Morris Cove.
" *triradiatus* Roper. Rare, Leete's Island.
Coscinodiscus excentricus Ehrenb. Frequent.
" *nitidus* Greg. Frequent.
" *symbolophorus* Grun. Occasional.
" *subtilis* Ehrenb. Rare, local.
" *marginatus* Ehrenb. Occasional.
" *radiatus* Ehrenb. Frequent.
" *concinnus* W. Sm. Frequent.
" *gigas* Ehrenb. Rare, Leete's Island.
" *asteromphalus* Ehrenb. Frequent.
" *oculus-iridis* Ehrenb. Frequent.
" *apiculatus* Ehrenb. Frequent.
Lysigonium moniliforme (Mull.) Link. (*Melosira Borreri* Grev.) Locally abundant.
" *varians* (Ag.) De Toni. (*Melosira varians* Ag.) Abundant.

Gallionella nummuloides (Dillw.) Bory. (*Melosira nummuloides* Ag.) Frequent.
Melosira undulata (Ehrenb.) Kütz. Frequent.
" *sculpta* (Ehrenb.) Kütz. Common.
" *coronata* Grun. New Haven.
" *octogona* Grun. Frequent.
Paralia sulcata (Ehrenb.) Cleve. Rare, Leete's Island.
Cyclotella antiqua W. Sm. Very rare, Bristol only.
" *striata* (Kütz.) Grun. Silver Sands.
" *Kuetzingiana* Thw. Frequent.
Podosira dubia (Kütz.) Grun. Occasional.
Hyalodiscus subtilis Bail. Occasional.
" *stelliger* Bail. Occasional.
Actinoptychus undulatus (Bail.) Ralfs. Common.
" *velatus* Ehrenb. Occasional.

Bristol, Connecticut.

THE GENUS SUAEDA IN NORTHEASTERN AMERICA.

M. L. Fernald.

The genus *Suaeda* has long been for the American botanist a source of much confusion and difficulty, in part because it consists of unattractive plants of saline soils which are generally ignored by collectors, in part because of the very indefinite conception of the true *Suaeda maritima* of Europe — the species about which our studies, at least of the eastern coast forms, must largely center. It has long been known to many New England botanists that we have on our northeastern coast more than the single species alloted to this region in Gray's Manual; and the two species described and figured (as *Dondia*) in Britton & Brown's Illustrated Flora satisfactorily cover only the forms which occur on the salt marshes and sea beaches from southern New England southward. On the coast of Maine are other forms which in habit, flowering-season, and fruit-characters are unlike the plants of the more southern shores.

During the summer of 1898 Mr. J. C. Parlin and the writer spent a day (July 23) upon Wells Beach and the adjacent marshes in southern Maine. At that time a small depressed *Suaeda* (no. 1) with short subcylindric dark green leaves was in mature fruit. Another depressed

and very slender plant (no. 2) with longer semicylindric very glaucous foliage was in flower and with occasional mature seeds. A third but scarce plant (no. 3), then beginning to fruit, had much coarser purple-tinged ascending and slightly branching stems, and the leaves only slightly glaucous. Two other species not then in flower were common — one an erect or ascending profusely branched green plant (no. 4) a foot or two high, the elongate-linear leaves not glaucous; the other a depressed plant (no. 5), at that time showing no trace of flowering, generally with the coarse stems and slender leaves purplish. Late in the following September additional collections and field notes were made about Wells Beach by Miss Kate Furbish. The two slender depressed plants (nos. 1 & 2) which had been in fruit nearly two months earlier were, at the time of these later observations, over-ripe or quite shrivelled, and the tall erect very branching plant (no. 4) was in mature condition, but the coarse decumbent plant (no. 5) with its green or generally claret-colored stems and leaves was barely in fruit. Its habit, however, and the very dense elongate-spicate inflorescences distinguished it superficially from the other plants near which it grew. An exhaustive study of the Suaedas of eastern Massachusetts recently made by Mr. Wm. P. Rich has shown that two forms — the tall late-fruiting species (no. 4) and the ascending plant (no. 3) noted as scarce on Wells Beach — are generally distributed along the Massachusetts coast, while a third plant, the slender depressed very glaucous form (no. 2) occurs on the North Shore.

A detailed examination of these five plants shows that besides their marked habital characters and their different fruiting seasons, at least four of them possess good differential characters in their calyces and seeds. These five New England plants divide themselves naturally into two groups — the first, with the sepals thickened and strongly carinate upon the back, including the two late-flowering plants (nos. 4 & 5); the second group, with the sepals thinner and rounded or very slightly carinate upon the back, including the three plants (nos. 1, 2, and 3) found fruiting in late July. The former group includes the plants now generally passing as *Suaeda linearis* (Ell.) Moq. (*Dondia Americana* Britton in part); and the three plants with the sepals more rounded on the back are included under *Suaeda maritima* (L.) Dum. (*Dondia maritima* Druce).

In order to make a satisfactory disposition of these forms it is necessary first to gain a clear conception of the European *Suaeda*

maritima. This unfortunately is not easily accomplished. The specimens distributed as this species from European herbaria are very different from one another, and, like the American plant, they are probably a confusion of several distinct things. The descriptions too are confusing. When one refers, however, to the original description of the Linnaean *Chenopodium maritimum*, upon which *Suaeda maritima* was founded he finds an indication that the name belongs to the plant which of late has been so called in America. At least, judging from an excellent photograph secured by Dr. B. L. Robinson of the specimen preserved at the British Museum, the plant first cited by Linnaeus (the Hortus Cliffortianus specimen) is our bushy-branched plant with large calyces and the achenes 2 mm. broad. The maturer specimens in the Linnaean Herbarium, as photographed by Dr. Robinson, seem also to be like the plant of Hortus Cliffortianus. This species is fortunately the plant represented in the plates cited by Moquin in his description of *Chenopodina maritima a vulgaris* in DeCandolle's Prodromus. These plates are two [1] and they represent a plant well known in our herbaria both from Europe and America. In habit, color, calyx and seed it is closely matched by the third form mentioned from Wells Beach, and found very generally on the Atlantic coast of America.

Our conception of *Suaeda linearis* (Ell.) Moq. has also been very confused. From his description Elliott's *Salsola linearis* is apparently a tall erect freely branching plant (no. 4) which is common on the Atlantic coast from southern Maine to Texas. Elliott cited, however, as synonyms two plants — *Salsola salsa*? Michaux and *Chenopodium maritimum* Walter — neither of which seems clearly identified with the "nearly erect....much branched" plant which he described. The erect bushy plant with the flowers "spiked" and with the sepals "angled on the back," as described by Elliott, has small seeds, rarely 1.5 mm. broad. The portion of Walter's specimen of *Chenopodium maritimum* preserved in the Gray Herbarium shows a plant apparently not distinguishable from the common *Suaeda maritima* of Europe and our northeastern coast. The fragment has the large flowers subtended by leaves which are much longer than in the commoner tall southern plant with its "spiked" flowers, the larger sepals are not distinctly carinate, and the large seed (2 mm. broad) is not different

[1] Oeder, Fl. Dan. iii. t. 489 (1770); Sm. Engl. Bot. t. 633 (1799).

from that of the European *Chenopodium maritimum.* Moquin in his monograph of the *Chenopodiaceae* transferred the tall plant to *Suaeda,* as *S. linearis,* following very closely Elliott's description. In DeCandolle's Prodromus, however, he states that the seeds are a line long,— the size of those in Walter's plant and in the common *S. maritima,* but much larger than in the common southern plant which closely matches Elliott's and Moquin's original descriptions. This large-seeded plant, with the leaves of the flowering branches usually elongated and with thin rounded sepals was accepted by Dr. Watson in his early studies of the group as true *Suaeda linearis* Moq. (*Salsola linearis* Ell.), and the small-seeded plant with carinate sepals, described by Elliott was treated as a variety of the species, var. *ramosa,* though later, in the 6th edition of Gray's Manual, he considered the common erect plant with small seed true *S. linearis.*

Under his *Suaeda linearis,* var. *ramosa,* Dr. Watson apparently without hesitation included as a synonym *Salsola salsa* Michaux, from the mouth of the St. Lawrence, a plant which had been included with hesitation by Moquin and others under *Suaeda linearis.* From the original Michaux material it is impossible to determine with certainty the exact identity of that plant; but that it is the same as the erect branching small-seeded *Suaeda linearis* (var. *ramosa* Wats.) of the southern coast is open to serious doubt. So far as exploration on the Maine coast and the lower St. Lawrence has shown, the tall small-seeded *S. linearis* rarely occurs east of the mouth of the Kennebec, nor has it been collected in the maritime provinces of Canada. In fact, north of Cape Anne the three species (excepting the local *S. linearis* of southern Maine) which we know are low plants of procumbent or at least wide-spreading or loosely branching habit. Michaux supposed the lower St. Lawrence plant to be the European *Salsola salsa,* and his primary descripion might well be that of the Old World plant; but in the accompanying observation he states that his American specimen differs from the European in its more slender subdecumbent habit and more crowded flowers.[1] The Michaux plant was soon distinguished by Persoon from the erect *Salsola salsa* as a variety, "*β? americana,* humilior, subdecumbens, flor. confertioribus."[2]

[1] "A. SALSOLA quæ maritima circa *Hâvre de Grace* et *Dieppe* incolit, in eo tantum differt, quod humilior sit et subdecumbens, floribus confertioribus."— Michx. Fl. i. 174 (1803).

[2] Pers. Syn. i. 296 (1805).

Subsequently the Michaux plant, as already stated, has been doubtfully placed by Moquin and others under the more southern *Suaeda linearis*, and by Dr. Watson it was included as a synonym under his tall erect but later discarded var. *ramosa*. And more recently, in the Illustrated Flora, Dr. Britton has taken up for the well-known Atlantic coast plant with "stem erect, strict, 1°–3° tall," the name used by Persoon to designate a "low subdecumbent" plant; and regarding Michaux's subdecumbent plant from the lower St. Lawrence as identical with the more southern erect species, he makes the new combination *Dondia Americana* (Pers.) Britton.

In the summer of 1903 the writer examined the Michaux type and at that time made the note: "Loosely branching *Suaeda*, very immature, but from the crowding of the flowers seems to be the same as the Norwood Cove and Wells Beach species of late September and October." This plant of Norwood Cove and Wells Beach (no. 5 of the preceding notes) is well characterized not only by its late fruiting and subprostrate habit but by its densely crowded flowers on spiciform branches, its very irregular calyx, and its rich claret-color in autumn; and it is apparently the plant intended by Persoon as *Salsola salsa*, var. *americana*.

The northeastern maritime Suaedas as understood by the writer may be classified as follows —

* Seed 2 mm. broad.

Suaeda maritima (L.) Dumort. Comparatively low, 0.5–4 (rarely 5 or 6) dm. high, ascending or depressed, subsimple or with spreading-ascending or decumbent subsimple branches, often even forming depressed mats 5 dm. or less in diameter: leaves usually more or less glaucous, linear, acute or obtusish, semicylindric, flat above, convex beneath, 5 cm. or less long; those of the flowering branches slightly shorter than the others and much exceeding the 1–4 axillary flowers: sepals pale-green, rounded or obscurely keeled on the back: seed red-brown or black. — Fl. Belg. 22 (1827); Moq. Ann. Sci. Nat. xxiii. 308 (1831), and Chenop. Enum. 127 (1840). *S. maritima a vulgaris* Moq. Chenop. Enum. 128 (1840). *S. linearis* Watson, Proc. Am. Acad. ix. 87 (1874) in part; Wats. & Coult. in Gray, Man. ed. 6, 435 (1890) in part; not Moq. *Chenopodium maritimum* L. Sp. 221 (1753); Oeder, Fl. Dan. iii. t. 489 (1770); Walter, Fl. Car. 111 (1788); Sm. Engl. Bot. ix. t. 633 (1799). *Atriplex maritima* Crantz, Inst. i. 208 (1766). *Salsola maritima* Poir. Encyc. vii. 291 (1806). *Schoberia maritima* C. A. Meyer in Ledeb. Fl. Alt. i. 400 (1829). *Cheno-*

podina maritima Moq. in DC. Prodr. xiii. pt. 2, 161 (1849). *C. maritima, a vulgaris* Moq. l. c. *Dondia maritima* Druce, Ann. Scot. Nat. Hist. (1896) 42; Britton & Brown, Ill. Fl. i. 585, t. 1394 (1896).— Common on wet marshes along the coast from Anticosti to Connecticut, and occasionally southward to Louisiana. Eurasia.

Walter's specimen of his *Chenopodium maritimum* from the Carolina coast is not readily distinguished from this, though his description is cited by Elliott under *Salsola linearis*. On the Massachusetts coast and southward the ascending bushy form of the plant prevails, but from Ipswich northward along the coast of Maine and Eastern Canada it often gives way to a more depressed and usually more glaucous plant, which, however, cannot be clearly separated from the other form. Apparently the same forms in the British Isles have a distribution parallel with this, for, according to Syme "the erect variety is more common in the south, the procumbent in the north; but it is scarcely possible to draw any line of demarcation between them" (Engl. Bot. ed. 3, viii. 4.).

* * Seed 1.25 to 1.5 mm. broad.

+— Sepals rounded on the back, not carinate.

S. Richii. Stems procumbent, forming mats 5 dm. or less across (often fruiting when only 1 cm. or so long): leaves dark green, not at all glaucous, linear to linear-oblong, bluntish, subcylindric, dorsally compressed, the lower 1.5 cm. or less in length; those subtending the fascicles of flowers broader and shorter (4 or 5 mm. long): seed black. — Common on salt marshes and in damp spots at the edge of the beach, Wells, Maine, Aug., 1892 (*Anne E. Perkins*), Sept. 16, 1895 (*Walter Deane*), July 23, 1898, TYPE (*J. C. Parlin & M. L. Fernald*), Sept. 1898 (*Kate Furbish*); also on Great Cranberry Isle, Maine, Aug. 30, 1892 (*E. L. Rand*), and at Cutler, Maine, Aug. 27, 1902 (*M. L. Fernald*). A very distinct species, in its procumbent habit suggesting the depressed form of *S. maritima*, but, in the field, quickly distinguished by its short blunt dark (not glaucous) green foliage, as well as its small seed. From the other small-seeded species, *S. linearis*, it is distinguished by its procumbent habit and short blunt leaves, as well as by the rounded (not carinate) sepals. Unlike any other American plant, this Suaeda in habit strongly suggests *S. microsperma* (C. A. Meyer) Fenzl, but that Asiatic plant has much smaller seeds, and the sepals cucullate-carinate.

This procumbent small-seeded plant of the Maine coast is named for William Penn Rich, a discriminating student of salt marsh vegetation, who in April, 1898, pointed out in the herbarium of Mr. Walter Deane the peculiarities of the species here described.

+— +— Sepals (or some of them) carinate on the back.

++ Stems procumbent: 1 or 2 sepals more cucullate-carinate than the others.

S. americana (Pers.) n. comb. Stems procumbent, the branches 2 or 3 dm. long, only the abundant flowering ones ascending: lower leaves linear, acute, about 2 cm. long; those of the densely-flowered ultimate branches broader and much shorter: one or two sepals usually much more cucullate-carinate than the others: entire plant generally becoming, in the autumn, a rich crimson-lake or claret-color. — *Salsola salsa*? Michx. Fl. i. 174 (1803), not L. *S. salsa, β.? americana* Pers. Syn. i. 296 (1805). *Dondia americana* Britton in Britton & Brown, Ill. Fl. i. 584, merely as to name-bearing synonym (1896).— Salt marshes, maturing from late September to November. Known only from the original Michaux material from the lower St. Lawrence, and from two stations on the coast of Maine,— Norwood Cove, Southwest Harbor, September 18, 1892 (*M. L. Fernald*) and Wells Beach, late September, 1898 (*Kate Furbish*); but in its very procumbent habit, dense subspicate inflorescence, and generally irregular calyx, apparently a very distinct species.

++ ++ Stems erect or ascending: sepals equally carinate.

S. LINEARIS (Ell.) Moq. Erect or ascending, 2 to 9 dm. high, profusely branched; the slender branches ascending or sometimes wide-spread, but not procumbent: leaves narrowly linear, dark green (not glaucous), 4 cm. or less long, those of the slender elongated flowering branches much shorter: sepals equally carinate.— Chenop. Enum. 130 (1840); Wats. Proc. Am. Acad. ix. 87 (1874), at least in part; Wats. & Coult. in Gray, Man. ed. 6, 435 (1890), in part; Chapm. Fl. ed. 3, 406 (1897). *S. linearis*, var. *ramosa* Wats. l. c. (1874), excluding syn. *Salsola salsa* Michx. & *S. salsa*, var. *americana* Pers. *S. maritima* Torr. (*Sueda*) Fl. N. Y. ii. 141 (1843); Gray, Man. 377 (1848); not Dumort. *Chenopodium maritimum* Pursh, Fl. 198 (1814), not *L. Salsola linearis* Ell. Sk. i. 332 (1817). *Chenopodina linearis* Moq. in DC. Prodr. xiii. pt. 2. 164 (1849). *C. maritima* Gray, Man. ed. 2, 366 (1856); Chapm. Fl. 378 (1860); not Moq. *Dondia Americana* Britton in Britt. & Brown, Ill. Fl. i. 584, t. 1393 (1896), excluding syn. *Salsola salsa*, var. *americana* Pers.— On the seacoast, chiefly in dryish sand or at the borders of marshes, from Maine to Texas; rare east of the Kennebec.

Gray Herbarium.

Flower Color of the American Diervillas.— The change in flower color which follows pollination in the Asiatic species of *Diervilla* § *Weigela* is often cited as a striking case of adaptation to pollination by bees. In all but one of the Weigelas the flowers are at first white or merely roseate-tinged, but after pollination they change quickly to deep rose or carmine, in which condition they remain fresh for some length of time, serving to attract bees to the shrub. Only the white flowers are visited for honey, however. Among the American species of *Diervilla*, which belong to a section of the genus distinguished from § *Weigela* by the smaller yellow flowers, the corresponding phenomenon seems to have been recorded only by Mrs. Dana. In "How to know the Wild Flowers" she says of *Diervilla Lonicera* Mill. (*D. trifida* Moench): "The lower lobe of the corolla is crested and more deeply colored than the others, thus advising the bee of secreted treasure. ....When the blossom has been despoiled and at the same time fertilized, for the nectar-seeking bee has probably deposited some pollen upon its pistil, the color of the corolla changes from a pale to a deep yellow...." Other observers have noticed that the flower of this species is not always "light yellow" or "honey yellow," but have apparently ascribed the differences to specific variability.

In shady woods the change in *Diervilla Lonicera* is not very noticeable, but in dry localities where the growth of the shrub is stunted, as for example on Mt. Chocorua, N. H., and on the summit of Great Blue Hill, near Boston, the flowers become deep scarlet. The lip is the first part to show signs of change and it remains always of a deeper hue than the rest of the corolla, becoming, on Blue Hill, almost maroon. At the Arnold Arboretum, where all the American Diervillas are cultivated under moderate conditions of shade and moisture, fresh flowers were compared with Ridgway's standard color scale and the following changes noted. In *D. Lonicera* Mill. the corolla is at first citron yellow. The lip changes to poppy red and the other lobes to scarlet. In *D. rivularis* Gattinger the change is from yellow to a lightly suffused, dull poppy red, most intense on the lip. In *D. sessilifolia* Buckley the citron yellow corolla changes to cadmium yellow except on the lip, which becomes orange. *D. splendens* Carrière, which Mr. Rehder is inclined to consider a hybrid between *D. Lonicera* and *D. sessilifolia*, changes from canary yellow to pale orange, with an orange lip. In this character, as well as in its time

of flowering, it resembles the latter of its supposed parents.— H. H. Bartlett, Gray Herbarium.

Maclura pomifera (Raf.) Schneider.— In the May issue of Rhodora (ix. 91) I noted the fact that the Osage Orange, a common hedge plant of the Middle West and an occasional escape from cultivation in New England, should according to the Vienna Rules of nomenclature bear the name *Maclura pomifera*. I was not aware at the time that this particular combination had been used in print. Through the kindness of Mr. Alfred Rehder of the Arnold Arboretum I learn that the binomial *Maclura pomifera* was published about a year earlier in a short supplement of the first volume of C. K. Schneider's detailed Illustriertes Handbuch der Lauholzkunde (i. 806). — B. L. Robinson, Gray Herbarium.

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CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY.— NEW SERIES, NO. XXXV.

THE SOIL PREFERENCES OF CERTAIN ALPINE AND SUBALPINE PLANTS.

M. L. Fernald.

The floras of alpine and subalpine districts are especially attractive to the field-botanist. The flowers of such regions are as a rule more showy in proportion to the size of the plants than in the lowland forms; while on mountain summits and slopes are found many species quite unknown in the habitable districts. And, owing to the steepness and exposure of the slopes, the plants of alpine and subalpine situations are ordinarily found in picturesque and even inaccessible localities:— on the faces of cliffs, in rock-crevices, or on talus-slopes formed from the overhanging cliffs. In this characteristic, of growing primarily on soils derived from the rock in place, our alpine plants are strongly contrasted with the most familiar vegetation of the lower and more habitable regions of New England, New York, and eastern Canada, a vegetation which is found on more or less mixed or transported soils — in our region chiefly of alluvial or glacial origin.

Aside from the somewhat unique habitat of many plants of high mountains and cliffs and their interest as species unknown or rarely seen in the lowland, these alpine plants present to the student of geographic botany a problem of peculiar fascination. In most cases their known distribution is seemingly very erratic. The typical plants of these regions, instead of occurring over broad and continuous areas of eastern Canada and the United States, are found in only a few very isolated situations; and not until they reach the high-northern districts of polar America or other boreal regions do they occur extensively or in closely contiguous large areas. *Empetrum nigrum,* for instance, the Crow-berry or Curlew-berry, is a characteristic trailing

shrub at the very highest points of the Adirondack, Green, and White Mountains, on the naked-topped mountains of Maine, on Mt. Albert and Table-top Mt. in Gaspé, on the rocks of Mt. Desert Island and the adjacent coast of Maine, New Brunswick and Nova Scotia; thence along the coast of Nova Scotia and the outer coast of Newfoundland to Labrador. About the Gulf of St. Lawrence it is somewhat local and usually confined to cold bogs or occasional cliffs. In other words, south of the St. Lawrence *Empetrum nigrum* is isolated in its distribution, occurring only on the higher mountain-summits and on cold coastal rocks or bogs. North of the St. Lawrence, however, it becomes one of the commonest of plants, " abundant throughout the semi-barren and barren regions of the [Labrador] peninsula, growing freely on the coast and inland,"[1] and according to Delabarre it is "the most abundant phenogamous plant of Labrador."[2] West of the Labrador Peninsula and Baffin Land it grows, according to Macoun, "along the north shore of Lake Superior, and at Port Arthur, ... Thence it takes a northwesterly direction and is found in peat bogs, on exposed rocks along the shores, and on barren grounds to the Pacific Ocean and Arctic Sea."[3] From the Arctic it extends southward along the Coast Range to the region of Sitka, and very locally on cliffs to the coast of northern California. It is also on the mountains of southern British Columbia, and locally in Washington; and it grows in arctic-alpine regions of Eurasia. *Rubus Chamaemorus*, the Baked-apple of the coastal region of eastern Maine, southern New Brunswick and Nova Scotia, is also on the higher White Mts. of New Hampshire and the adjacent high peaks of western Maine, but unknown on other New England mountains; locally on bogs of Temiscouata and Rimouski Counties, Quebec, and on Table-top Mt. in Gaspé. From these isolated areas south of the St. Lawrence it extends northward along the outer coast of Newfoundland, and from the north shore of the St. Lawrence "everywhere throughout Labrador to beyond the tree limit"[4]; through Arctic and subarctic regions to Alaska, coming south along the Coast Range to the region of Sitka. Many other characteristic plants of the isolated alpine or colder areas of

[1] Low, Report on Explorations in the Labrador Penninsula: Geol. Surv. Can., Ann. Rep., n. s. viii. 40 L. (1896).

[2] Delabarre, Bull. Geogr. Soc. Phila. iii. no. 4, 190 (1902).

[3] Macoun, Cat. Can. Pl i. 458 (1886).

[4] Low, l c. 38 L. (1896).

Maine and New Hampshire are, like *Empetrum nigrum* and *Rubus Chamaemorus*, the common plants of Labrador and other subarctic and arctic regions of America. Another large group of isolated species is well represented by *Dryas Drummondii*, one of the commonest and most showy plants of the ledgy shores and gravelly beaches of the Gaspé Peninsula and of Anticosti Island. This beautiful shrub, so common in Gaspé and Anticosti, is quite unknown elsewhere east of the Rocky Mts. There, however, it is found throughout the System from northwestern Montana northward, along alpine rivers to the shores of the Arctic Sea.[1]

When, on the other hand, we examine the detailed distribution of the plants which characterize the low altitudes, or at least the every-day inhabited portions of New England and eastern Canada, a very different situation is found. The most familiar plants of these regions, instead of occurring only at few and remote highly specialized stations, are of general or continuous distribution over broad and easily defined areas. Thus, to cite a few typical illustrations, *Clematis virginiana* occurs along streams from the Baie des Chaleurs to Georgia, and west to Lake Winnipeg and the Mississippi valley. *Anemonella thalictroides* is common in dry woods from southern New Hampshire westward to southern Ontario and Minnesota, south to Maryland, and in the upland country to western Florida. *Viola conspersa*[2] occurs very generally in alluvial woods and thickets or in wild meadows from southern Gaspé and eastern New Brunswick west to the Great Lake region, south to Maryland, West Virginia and southern Indiana, and locally along the mountains southward. *Ilex monticola* grows in rich woods of the Alleghanies from northern Alabama northward across Pennsylvania, and locally to the Taconic Mountains of southwestern Massachusetts and the hill-country of western New York. *Aster subulatus* in its general distribution follows the coastal marshes from New Hampshire to Florida. These five species of *Clematis, Anemonella, Viola, Ilex,* and *Aster,* illustrate very fairly the general and continuous distribution of a large proportion of our plants of the north-temperate regions.

The isolation above indicated of the alpine and subalpine plants in New England, Nova Scotia, New Brunswick, and Quebec (as well as on the Adirondack Mts. and in other cold areas of New York, on the

[1] See Macoun, Cat. Can. Pl. i. 132 (1883).

[2] *Viola conspersa* Reichenb. (*V. canina* L., var. *Muhlenbergii* Trautv.).

north shore of Lake Superior, and at other similar points) is of course due in part to the fact that we have in this large district only a limited number of regions in which the climatic conditions are comparable with those of the Arctic. And the occurrence in exposed or frigid situations of Mt. Washington or along the Gaspé rivers of such isolated species as *Empetrum nigrum*, *Rubus Chamaemorus* and *Dryas Drummondii* is one of the strong links of evidence which has convinced botanists of the inevitableness of the conclusions long ago reached by Hooker, Gray, and others, that it is "difficult to account for these facts, unless we admit Mr. Darwin's hypotheses, first, that the existing Scandinavian flora is of great antiquity, and that previous to the glacial epoch it was more uniformly distributed over the polar zone than it is now; secondly, that during the advent of the glacial period this Scandinavian vegetation was driven southward in every longitude, and even across the tropics into the south temperate zone; and that on the succeeding warmth of the present epoch, those species that survived both ascended the mountains of the warmer zones, and also returned northward accompanied by aborigines of the countries they had invaded during their southern migration. Mr. Darwin shows how aptly such an explanation meets the difficulty of accounting for the restriction of so many American and Asiatic arctic types to their own peculiar longitudinal zones, and for what is a far greater difficulty, the representation of the same arctic genera by most closely allied species in different longitudes."[1]

Practically every newly explored alpine district or cliff-region of New England and eastern Canada furnishes its addition to the already extensive list of polar and high-northern species which are isolated south of the St. Lawrence; and to-day we know in this area, between Long Island Sound and the mouth of the River St. Lawrence, more than four hundred such *Pteridophyta* and *Spermatophyta*, a list which would be significantly increased by the addition of the lower groups of plants. But the discovery of a few additions to this very long list of arctic-alpine and high-northern plants south of the St. Lawrence, however interesting it always proves, is, in view of the extensive data already amassed, only of minor importance compared with the greater problem of determining the reasons for this isolated distribution.

[1] J. D. Hooker, Outlines of the Distribution of Arctic Plants: Trans. Linn. Soc. xxiii. pt. 2, 253 (1861). See also Darwin, Origin of Species, Chap. XI; Gray, Am. Journ. Sci. Ser. 2, xxxiv. 144 (1862).

For several years the writer has realized that, in the available information on the occurrence of these plants, a most important factor is missing; and since 1893 much of his field-observation has been directed toward a possible solution of the problem. During the past fourteen summers he has examined over thirty of the mountains of New England and eastern Canada which support more or less pronounced arctic-alpine floras; the cold cliffs of the Maine coast at various points from York to Cutler; the shores of the Bay of Fundy and the southern and eastern coasts of Nova Scotia at remote points; the coast of northeastern New Brunswick and of the Gaspé Peninsula; and the sea-cliffs of the south shore of the St. Lawrence westward to Temiscouata County, Quebec. The studies of these areas and of many river cliffs of northern Maine and eastern Quebec, supplemented by the detailed collections of other botanists and their publications upon the floras of various cliffs and alpine summits, especially of the White and Green Mountains, have furnished the basis for the conclusions here to be presented. In the explorations of the past few summers the writer has had the enthusiastic coöperation of Professor J. Franklin Collins, without whose ever ready ingenuity at "roping" difficult cliffs, it would have been impossible to secure many of these observations.

One of the first impressions gained in botanizing on Willoughby Cliffs or in Smuggler's Notch or on the sea-cliffs of Bic or of Percé, for instance, then on Mt. Washington or Katahdin or Table-top Mt., and then on Mt. Albert, is that alpine floras are very dissimilar. This difference has often been remarked. Dr. A. J. Grout, for example, in describing an ascent of Mt. Washington through Tuckerman's Ravine, says:

"After a climb of about two hours we came into Tuckerman's Ravine proper where the alpine plants began to appear. This reminds one strongly of the Smuggler's Notch ravines, on a much larger scale and the path to the summit zigzags back and forth over towering cliffs similar but less abrupt. One of the most striking things to me was the difference in the flora here and elsewhere on Mt. Washington and that of Smuggler's Notch and Mt. Mansfield. Here in Tuckerman's Ravine were *Salix phylicifolia* both sexes, *Alnus alnobetula* [*A. crispa*] and a number of more common alpine plants, but no *Pinguicula*, neither of our alpine Saxifrages, nor did I see any of our

rare alpine ferns; no *Artemisia Canadensis*, *Arenaria hirta* [*A. verna*, var. *propinqua*], *Hedysarum* or *Astragalus*. However this deficiency was atoned for by the bright yellow *Arnica Chamissonis* [*A. mollis*], strongly resembling a dwarf sunflower; *Oxyria digyna*, whose very looks seemed to say: 'a near relative of our sorrel'; *Gnaphalium supinum*, which one could easily mistake for our common *G. uliginosum*; *Phleum alpinum* that looks just like dwarfed timothy; *Salix argyrocarpa* in fine fruit, and a form called a hybrid between this and *S. phylicifolia*. Besides these more striking forms, we also collected here *Veronica alpina*, *Sibbaldia procumbens*, *Loiseleuria procumbens*, *Epilobium alpinum*, and *Geum radiatum* [*G. Peckii*]." [1]

Later, at a meeting of the Torrey Botanical Club, Dr. Grout contrasted the flora of the Smuggler's Notch region of Mt. Mansfield; where "are found *Dryopteris* [*Aspidium*] *fragrans*, *Woodsia glabella* and *W. alpina*, *Pellaea gracilis* [*Cryptogramma Stelleri*], *Polystichum Braunii*, *Asplenium viride*, *Blephariglottis grandiflora* [*Habenaria fimbriata*], *Saxifraga oppositifolia*, *S. Aizoön*, and *S. autumnalis* [*S. aizoides*], *Astragalus Jesupi* [*A. Blakei*], *Hedysarum Americanum* [*H. boreale*], *Draba incana* [*D. stylaris*], *Arenaria verna* [var. *propinqua*], *Pyrola minor*, *Gentiana acuta* [*G. Amarella*, var. *acuta*], *Castilleja acuminata* [*C. pallida*, var. *septentrionalis*], *Erigeron hyssopifolius*, *Solidago Virgaurea*, vars. and that choicest of beauties and wonders, the insect-eating *Pinguicula vulgaris*";[2] with that of the summit-ledges, where are found "*Polygonum viviparum*, *Comandra livida*, *Viburnum pauciflorum*, *Salix Uva-ursi*, *Vaccinium caespitosum*, *V. uliginosum*, *Vitis-Idaea*, *Nabalus* [*Prenanthes*] *Boottii* and *Diapensia*";[2] and in the abstract of this address, as published, the concluding paragraph reads: "A comparison of the flora of this region and that of Mt. Washington, brings out the fact that here are several northern plants not found at the loftier elevation of the Mt. Washington region, although the conditions there are more severely alpine and supposedly more favorable. None of the saxifrages mentioned above can be found in the White Mountain region, but another alpine species, *S. rivularis*, occurs there. This is only one of several cases hard to account for, on a theory of a residual flora, as the regions are so near to each other and the conditions are so similar." [2]

[1] A. J. Grout, Plant World, ii. 116 (1899).
[2] A. J. Grout, as reported by N. L. Britton, Torreya, ii. 47 (1902).

Had the plants of Smuggler's Notch and of Mt. Washington been further compared with the flora of the great alpine tableland of Mt. Albert in Gaspé the contrast would have been quite as marked, for on that broad expanse of bare summit and cañon-walls the characteristic plants are unlike those either of Mt. Washington or of Smuggler's Notch, and in their stead we find extensive areas of *Adiantum pedatum*, var. *aleuticum*, *Festuca altaica*, *Salix desertorum*, *Arenaria arctica*, *Statice sibirica*, *Solidago decumbens*, *Artemisia borealis*, and many other plants which are unknown elsewhere south of the St. Lawrence.

If, however, comparison is made of the floras of Smuggler's Notch and of Willoughby Cliffs, many sea-cliffs of Bic and the north coast of Gaspé, the mountain- and sea-cliffs of Percé, the cliffs of certain spurs abutting on the northwestern edge of Table-top Mountain, and various river-cliffs in northern Maine, New Brunswick, and the interior of the Gaspé Peninsula; we shall find a remarkable similarity in their floras. In fact, of the 29 distinctively cliff or subalpine plants of Smuggler's Notch all but the local *Astragalus Blakei* are known from the sea-cliffs of Bic and the Gaspé coast, the river-cliffs of the Gaspé interior, or the northwestern abutments of Table-top Mountain; while on the neighboring cliffs of Willoughby only 18 of the 29 notable Smuggler's Notch species are found, though a few others are there present. Furthermore, on the more northern and ordinarily more exposed cliffs of the Gaspé mountains and coast many additional plants are associated with those of Smuggler's Notch and of Willoughby Cliffs; but on none of these areas (except Table-top Mt. discussed below) is there a noteworthy identity with the alpine flora of Mt. Washington.

When, on the other hand, we compare the characteristic alpine flora of Mt. Washington and the adjacent White Mountains with that of Mt. Katahdin or the great alpine tableland (15 miles long, by 3 or more miles wide) of Table-top Mountain, or the coastal cliffs of eastern Maine, we find a striking similarity in these floras. Some of these areas support one or more plants not known in either of the others,[1] but on these three great mountain areas the characteristic species are identical, while several of them occur on the coast of eastern

[1] *Carex capitata*, *Geum Peckii*, *Saxifraga rivularis*, and *Euphrasia Williamsii* on Mt. Washington; *Carex Grahami*, *C. saxatilis*, *C. katahdinensis*, and *Saxifraga stellaris*, var. *comosa* on Katahdin; *Phegopteris alpestris*, *Asplenium cyclosorum*, *Cerastium cerastioides*, *Petasites vitifolia* and *P. trigonophylla* on Table-top Mountain.

Maine and adjacent New Brunswick, on the highest of the Adirondacks, and on several lesser mountains of New England and New Brunswick not here enumerated.

Furthermore, at the exposed summits of Mt. Mansfield and of Camel's Hump in Vermont, where the distinctive plants of Smuggler's Notch are mostly unknown, the following alpine and subalpine plants are found:

Lycopodium Selago L., var. *appressum* Desv.
Agrostis borealis Hartm.
Calamagrostis Pickeringii Gray.
Deschampsia atropurpurea (Wahl.) Scheele.
Hierochloe alpina (Sw.) R. & S.
Poa laxa Haenke.
Carex brunnescens Poir.
" *Michauxiana* Boeckl.
" *rigida* Good., var. *Bigelowii* (Torr.) Boott.
Scirpus caespitosus L.
Juncus filiformis L.
" *trifidus* L.
Luzula parviflora Desf.
Salix balsamifera Barratt.
" *phylicifolia* L.
" *Uva-ursi* Pursh.
Alnus crispa (Ait.) Pursh.
Betula alba L., var. *minor* (Tuckerm.) Fernald.
Comandra livida Richardson.
Polygonum viviparum L.
Arenaria groenlandica (Retz.) Spreng.
Amelanchier oligocarpa (Michx.) Roem.
Potentilla tridentata Ait.
Empetrum nigrum L.
Ledum groenlandicum Oeder.
Vaccinium caespitosum Michx.
" *uliginosum* L.
" *canadense* Kalm.
" *pennsylvanicum* Lam., var. *angustifolium* (Ait.) Gray.
" *Vitis-Idaea* L., var. *minus* Lodd.
Solidago Virgaurea L., var. *alpina* Bigel.
Prenanthes Boottii (DC.) Gray.

Of these 32 alpine and subalpine plants of the high summit-areas of the Green Mountains, plants which are quite different from the distinctive species of the Smuggler's Notch cliffs, 29 are common species of Mt. Washington, Katahdin, and Table-top Mountain; and the remaining 3, although as yet unknown from Table-top, are familiar plants of Mt. Washington and others of the White Mountains, of Katahdin, and even of some of the minor mountains of Maine.

As already remarked, the characteristic plants of the great tableland of Mt. Albert are, so far as known, unique in our flora; and, judging from our very limited knowledge of certain botanically unexplored mountains it is possible that upon them still other alpine or subalpine floras exist. Nevertheless, admitting that there are still highly promising mountains and cliffs within our boundaries whose plants are quite unknown to us, we already have sufficient data to point out three very

clearly defined floras which are quite absent from certain alpine and subalpine areas, but as positively the distinctive plants of certain others.

In the accompanying table is shown the known distribution south of the St. Lawrence and east of the Great Lake region and western New York of 258 alpine and subalpine *Pteridophyta* and *Spermatophyta*. This list includes a large proportion of the New England species, but owing to the lack of sufficiently accurate knowledge of the distribution of certain alpine plants (especially in eastern Canada) they are for the present omitted. Many other species belonging to such perplexing genera as *Calamagrostis, Poa, Salix, Epilobium, Campanula, Solidago, Aster*, etc., must await more detailed study before they can be satisfactorily identified.

It should be borne in mind that, in the preparation of these tables of distribution, only the alpine and subalpine habitats have been included, i. e., the localities in which the plants occur upon soils in place, either upon summit-ledges and upper slopes or on exposed cliffs and talus. In a few cases plants may be present in the bogs or swamps of a given region, but unknown in the rock-habitats. Such species are *Rubus Chamaemorus* and *Menyanthes trifoliata*, for instance, abundant in certain bogs along the lower St. Lawrence, but apparently unknown from the adjacent sea-cliffs and consequently not included from them in the table.

In tabulating the distribution of plants of regions which are not known to the writer from personal observation, it has not always been possible to secure full data, and many plants which are probably present in these localities are necessarily left unchecked. Some of the members of the *Pinaceae*, for example, are undoubtedly upon the cliffs of Smuggler's Notch, but the published lists of plants of that region have naturally laid more emphasis upon the localized species than upon those which are common throughout the Green Mountains, and the presence of many of the latter may be only assumed.

Of the 258 plants whose alpine and subalpine distribution is here tabulated, many species, it will be noticed, are confined very definitely to certain alpine areas, and are quite unknown from certain others. These areas which are characterized by distinctive floras fall into three major groups, and a fourth or minor group (of a single area) supporting a flora which embraces to a striking degree a mixture of plants which are otherwise confined very exclusively to one or the other of two of the major groups of areas.

TABLE I, SHOWING THE DISTRIBUTION SOUTH OF THE RIVER ST. LAWRENCE OF 258 ALPINE AND SUBALPINE PLANTS.

Names of Plants	Group I							Ia	II								III
	Adir. Mts.[1]	Green Mts.[2]	White Mts.[3]	Katahdin.[4]	Lesser Mts., Me.[5]	E. Coast, Me.[6]	Tableland, Table-top.[7]	N. Edge, Albert.[8]	Smuggler's Notch.[9]	Willoughby.[10]	St. John R.[11]	Restigouche R.[12]	Gaspé Rivers.[13]	Bic.[14]	Gaspé Coast.[15]	N. W. Edge, Table-top.[16]	Tableland, Albert.[17]
Lycopodium Selago L., var. appressum Desv.	+	+	+	+	+	+	+	+									+
var. patens (Beauv.) Desv.									+				+	+	+		
alpinum L.							+	+									
sitchense Ruprecht			+	+	+		+	+									
annotinum L., var. pungens Desv.	+	+	+	+	+	+	+	+									
Selaginella selaginoides (L.) Link								+			+	+	+		+	+	+
Adiantum pedatum L., var. aleuticum Rupr.																	+
Cryptogramma densa (Brack.) Diels																	+
Stelleri (Gmel.) Prantl									+	+	+	+	+	+	+		
Phegopteris alpestris (Hoppe) Mett.							+										
Robertiana (Hoffm.) A. Br.												+	+				
Cystopteris fragilis (L.) Bernh.								+	+	+	+	+	+	+	+	+	
montana (L.) Bernh.								+					+			+	
Asplenium viride Huds.									+	+	+		+	+	+		
cyclosorum (Rupr.) Fernald*							+										
Polystichum Lonchitis (L.) Roth															+	+	
scopulinum (Eaton) Maxon																	+
Aspidium fragrans (L.) Sw.									+		+	+	+	+	+		
Woodsia glabella R. Br.									+	+	+	+	+		+		
alpina (Bolton) S. F. Gray									+	+	+	+	+	+	+		
oregana D. C. Eaton														+			
scopulina D. C. Eaton															+		
Larix laricina (DuRoi) Koch			+	+		+				+			+		+		+
Picea mariana (Mill.) BSP.	+	+	+	+	+	+	+	+		+			+	+	+	+	+
canadensis (Mill.) BSP.	+	+	+		+	+	+	+		+	+	+	+	+	+	+	+
Abies balsamea (L.) Mill.	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+
Juniperus communis L., var. montana Ait.															+	+	+
Hierochloe alpina (Sw.) R. & S.	+	+	+	+	+		+	+									
Phleum alpinum L.			+	+			+	+				+	+		+		
Agrostis borealis Hartm.	+	+	+	+	+		+	+					+	+	+	+	+
Calamagrostis Pickeringii Gray	+	+	+				+										
Langsdorfii (Link) Trin.	+	+	+	+	+		+	+									
hyperborea Lange									+	+			+		+		
purpurascens R. Br.														+			
Deschampsia atropurpurea (Wahl.) Scheele	+	+	+	+			+	+									
caespitosa(L.) Beauv., var. alpina Vasey																	+

*ASPLENIUM **cyclosorum** (Rupr.) comb. nov. *Athyrium cyclosorum* Rupr. Beitr. Pflanzenk. Russ. Reich. iii. 41 (1845).

[1], [2], [3], etc. For notes see page 165.

TABLE I —*continued.*

Names of Plants	Group I							Ia	II								III
	Adir. Mts.	Green Mts.	White Mts.	Katahdin.	Lesser Mts., Me.	E. Coast, Me.	Tableland, Table-top.	N. Edge, Albert.	Smuggler's Notch.	Willoughby.	St. John R.	Restigouche R.	Gaspé Rivers.	Bic.	Gaspé Coast.	N. W. Edge, Table-top.	Tableland, Albert.
Danthonia intermedia Vasey																	+
Trisetum melicoideum (Michx.) Vasey								+			+	+	+		+	+	
Poa alpina L.							+	+				+	+	+	+	+	
laxa Haenke	+	+	+	+			+										
Sandbergii Vasey														+	+		
Festuca altaica Trin.																	+
rubra L., var. prolifera Piper			+	+												+	
ovina L., var. brevifolia (R. Br.) Hack.									+					+		+	
Scirpus caespitosus L.	+	+	+	+	+	+	+	+	+		+						+
pauciflorus Lightf.										+	+	+			+		
Eriophorum callitrix Cham.	+	+	+		+	+	+	+									
Chamissonis C. A. Meyer							+	+									+
var albidum (F. Nyl.) Fernald							+										
Rynchospora capillacea Torr.										+	+						
Carex lagopina Wahl.								+									
canescens L.	+	+	+			+		+									+
var. subloliacea Laest.		+	+		+	+	+										
brunnescens Poir.	+	+	+	+	+	+	+	+						+	+	+	+
stellulata Good.	+	+	+	+	+	+	+	+									
obtusata Lilj.															+	+	
Backii Boott														+	+		
capitata L.			+														
scirpoidea Michx.	+		+	+			+	+	+	+	+		+		+	+	+
deflexa Hornem.			+	+	+	+	+	+									
concinna R. Br.												+	+	+	+	+	
eburnea Boott									+	+	+	+	+	+	+		
bicolor All.											+	+	+				
vaginata Tausch								+			+			+	+	+	
capillaris L.			+												+	+	
var. elongata Olney								+			+	+	+	+	+	+	
paupercula Michx.																	+
var. irrigua (Sm.) Fernald	+	+	+		+	+	+	+									+
limosa L.	+		+		+	+	+										+
rariflora Smith				+			+										
rigida Good.																	+
var. Bigelowii (Torr.) Boott	+	+	+	+	+		+	+									+
lenticularis Michx.	+	+	+	+	+	+	+										
atrata L., var. ovata Boott			+	+			+	+	+		+	+	+	+	+	+	
alpina Sw.												+	+				

TABLE I—*continued.*

Names of Plants	Group I							Ia	II								III
	Adir. Mts.	Green Mts.	White Mts.	Katahdin.	Lesser Mts., Me.	E. Coast, Me.	Tableland, Table-top.	N. Edge, Albert.	Smuggler's Notch.	Willoughby.	St. John, R.	Restigouche R.	Gaspé Rivers.	Bic.	Gaspé Coast.	N. W. Edge, Table-top.	Tableland, Albert.
Carex oligosperma Michx.	+		+			+	+										
Grahami Boott				+													
saxatilis L.				+													
var. miliaris (Michx.) Bailey				+			+										
Michauxiana Boeckl.	+	+	+		+	+	+										
pauciflora Lightf.	+	+	+			+	+	+									
Juncus filiformis L.	+	+	+	+	+	+	+										
trifidus L.	+	+	+	+	+		+	+									+
castaneus Smith																+	
alpinus Vill.										+	+	+	+	+	+		
Luzula parviflora Desv.	+	+	+	+	+		+	+		+	+		+	+	+	+	+
spicata (L.) DC.	+		+	+			+	+	+							+	
var. tenella Meyer								+									
confusa Lindeb.			+	+			+										
Tofieldia palustris Huds.																+	
glutinosa (Michx.) Pers.											+	+	+		+		
Zygadenus chloranthus Richards.												+	+	+	+		
Cypripedium parviflorum Salisb.												+	+		+		
Habenaria dilatata (Pursh) Gray	+		+	+			+	+									+
Microstylis monophyllos (L.) Lindl.										+				+	+		
Salix vestita Pursh															+	+	
Barclayi Anders.																+	
pseudo-myrsinites Anders.																+	
argyrocarpa Anders.			+	+			+										
desertorum Richards																	+
var. stricta Anders.																	+
chlorolepis Fernald																	+
glauca L.								+								+	
phylicifolia L.		+	+	+			+	+									
balsamifera Barratt	+	+	+	+	+	+											
pedicellaris Pursh	+		+				+	+									
Uva-ursi Pursh	+	+	+	+	+		+	+									
herbacea L.			+	+			+	+									
Betula alba L., var. minor (Tuck.) Fernald	+	+	+	+			+	+									+
glandulosa Michx.	+		+	+			+	+									+
Alnus crispa (Ait.) Pursh	+		+	+			+	+				+	+	+	+	+	
mollis Fernald	+	+	+	+	+	+					+	+	+	+	+		
Comandra livida Richards.		+	+	+	+		+	+									+
Oxyria digyna (L.) Campt.			+					+								+	
Lychnis alpina L.																	+

TABLE I—*continued.*

Names of Plants	Group I: Adir. Mts.	Green Mts.	White Mts.	Katahdin.	Lesser Mts., Me.	E. Coast, Me.	Tableland, Table-top.	Ia: N. Edge, Albert.	II: Smuggler's Notch.	Willoughby.	St. John R.	Restigouche R.	Gaspé Rivers.	Bic.	Gaspé Coast.	N. W. Edge, Table-top.	III: Tableland, Albert.
Silene acaulis L.			+				+	+									+
Cerastium arvense L.						+		+			+			+	+		+
beeringianum Fisch.														+	+		
cerastioides (L.) Britton							+										
Sagina saginoides (L.) Britton								+									
Arenaria arctica Stev.																	+
sajanensis Willd.																	+
ciliata L., var. humifusa Hornem.																	+
verna L., var. propinqua (Richards.) Fernald									+					+	+		+
groenlandica (Retz.) Spreng.	+	+	+	+	+	+	+										
Anemone parviflora Michx.								+			+	+	+		+	+	
multifida Poir.											+	+	+	+	+		
riparia Fernald										+	+	+	+	+	+		
Ranunculus pygmaeus Wahl.								+									
Allenii Robinson								+									
Thalictrum alpinum L.													+		+		
Subularia aquatica L.			+			+	+										
Braya humilis (C. A. Meyer) Robinson										+							
Cardamine bellidifolia L., var. laxa Lange			+	+			+										
Draba incana L.															+		
var. confusa (Ehrh.) Poir.															+		
stylaris Gay									+	+	+			+			
megasperma Fernald & Knowlton															+		
pycnosperma Fernald & Knowlton															+		
arabisans Michx.									+	+			+	+	+		
var. orthocarpa Fernald& Knowlton													+	+	+		
corymbosa R. Br.																+	
aurea Vahl														+			
Arabis alpina L.								+					+		+	+	
hirsuta Scop.											+	+	+	+	+		
Drummondi Gray											+	+	+	+	+		
Collinsii Fernald														+			
Saxifraga nivalis L.																+	
stellaris L., var. comosa (Poir.) Willd.				+													
rivularis L.			+														
oppositifolia L.									+	+					+	+	
Aizoon Jacq.									+	+	+		+	+	+	+	
aizoides L.									+	+			+		+	+	

Table I—*continued.*

Names of Plants	Group I							Ia	II								III
	Adir. Mts.	Green Mts.	White Mts.	Katahdin.	Lesser Mts., Me.	E. Coast, Me.	Tableland, Table-top.	N. Edge, Albert.	Smuggler's Notch.	Willoughby.	St. John R.	Restigouche R.	Gaspé Rivers.	Bic.	Gaspé Coast.	N. W. Edge, Table-top.	Tableland, Albert.
Saxifraga caespitosa L.														+	+		
Parnassia parviflora DC.													+		+		
Kotzebuei C. & S.								+					+		+	+	
Rubus arcticus L.							+	+									+
Chamaemorus L.			+		+	+	+										
castoris Fries							+	+									
triflorus Richards.	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+
Potentilla nivea L.														+	+	+	
Robbinsiana Oakes			+														
tridentata Ait.	+	+	+	+	+	+	+	+			+			+	+		+
palustris (L.) Scop.						+	+										
Sibbaldia procumbens L.			+				+	+									
Geum Peckii Pursh			+		+												
Dryas integrifolia Vahl															+	+	
Drummondii Richardson													+				
Astragalus alpinus L.											+	+					
elegans (Hook.) Britton											+	+	+				
Blakei Eggleston									+	+	+						
frigidus (L.) Gray, var. americanus (Hook.) Watson													+				
Oxytropis campestris (L.) DC., var. johannensis Fernald											+	+	+				
Hedysarum boreale Nutt.									+	+	+	+	+	+	+		
Empetrum nigrum L.	+	+	+	+	+	+	+	+									+
var. andinum DC.			+	+	+												
Rhamnus alnifolia L'Her.											+		+		+	+	
Viola nephrophylla Greene										+	+	+	+	+	+		
palustris L.			+				+	+									
labradorica Schrank *			+	+			+	+			+				+		
Shepherdia canadensis (L.) Nutt.											+	+	+	+	+		
Elaeagnus argentea Pursh													+				
Epilobium alpinum L.			+				+	+									
anagallidifolium Lam.				+			+	+									
Pyrola grandiflora Radius																+	
Ledum groenlandicum Oeder	+	+	+	+	+	+	+	+									+
Rhododendron canadense (L.) BSP.			+	+	+	+											
lapponicum (L.) Wahl.	+		+	+	+		+	+									+
Loiseleuria procumbens (L.) Desv.			+	+			+	+									+

**V. labradorica* Schrank, not *V. conspersa* Reichenb. (*V. canina*, var. *Muhlenbergii* Gray).

TABLE I —*continued*.

Names of Plants	Group I							Ia	II								III
	Adir. Mts.	Green Mts.	White Mts.	Katahdin.	Lesser Mts., Me.	E. Coast, Me.	Tableland, Table-top.	N. Edge, Albert.	Smuggler's Notch.	Willoughby.	St. John R.	Restigouche R.	Gaspé Rivers.	Bic.	Gaspé Coast.	N. W. Edge, Table-top.	Tableland, Albert.
Kalmia angustifolia L.	+		+	+	+	+											+
polifolia Wang.	+		+	+	+	+	+	+									+
Phyllodoce caerulea (L.) Gren. & Godr.			+	+			+	+									+
Cassiope hypnoides (L.) D. Don	+		+	+			+	+									
Andromeda glaucophylla Link			+	+	+	+	+	+									+
Chamaedaphne calyculata (L.) Moench	+			+	+	+	+										+
Arctostaphylos Uva-ursi (L.) Spreng.														+			+
alpina (L.) Spreng.			+	+	+		+	+									
Vaccinium uliginosum L.	+	+	+	+	+	+	+	+									+
caespitosum Michx.	+	+	+	+	+		+	+			+						
ovalifolium J. E. Smith							+	+									
canadense Richards.	+	+	+	+	+	+	+										+
pennsylvanicum Lam., var. angustifolium (Ait.) Gray	+	+	+	+	+	+	+	+									+
Vitis-Idaea L., var. minus Lodd.		+	+	+	+	+	+	+									+
Oxycoccus L.	+		+	+	+	+	+	+									+
Diapensia lapponica L.	+	+	+	+	+		+	+									+
Primula mistassinica Michx.									+	+	+	+	+		+	+	
farinosa L., var. macropoda Fernald											+			+	+		
Statice sibirica (Turcz.) Ledeb.																	+
Gentiana Amarella L., var. acuta (Michx.) Herder									+		+	+		+	+		
Menyanthes trifoliata L.						+	+										
Lappula deflexa (Wahlenb.) Garcke															+		
Veronica alpina L., var. unalaschcensis C. & S.			+	+			+	+									
Castilleja pallida (L.) Benth., var. septentrionalis (Lindl.) Gray		+	+	+			+	+	+		+	+	+		+	+	+
Euphrasia borealis Towns.															+		
latifolia Pursh.											+		+		+		
Oakesii Wettstein			+	+													
Williamsii Robinson			+														
Pedicularis flammea L.																+	
Rhinanthus oblongifolius Fernald	+		+	+			+										
Pinguicula vulgaris L.									+			+	+		+	+	
Galium kamtschaticum Steller	+	+	+	+			+	+									
Viburnum pauciflorum Pylaie		+	+	+	+		+	+			+		+	+	+		+
Lonicera caerulea L., var. villosa (Michx.) T. & G.	+		+	+	+	+	+	+									+
Valeriana sylvatica Banks *													+			+	
Campanula uniflora L.																+	

* *V. sylvatica* Banks, not *V. uligihosa* (T. & G.) Rydberg, which is the plant of Arbor Vitae swamps of New England, New York, and the Great Lake region.

Table I —*continued.*

Names of Plants	Group I: Adir. Mts.	Green Mts.	White Mts.	Katahdin.	Lesser Mts., Me.	E. Coast, Me.	Tableland, Table-top.	Ia: N. Edge, Albert.	II: Smuggler's Notch.	Willoughby.	St. John R.	Restigouche R.	Gaspé Rivers.	Bic.	Gaspé Coast.	N. W. Edge, Table-top.	III: Tableland, Albert.
Lobelia Kalmii L.										+	+	+	+	+			
Solidago decumbens Greene																	+
multiradiata Ait.															+	+	+
ambigua Pursh																+	
Virgaurea L., var. alpina Bigel.	+	+	+	+	+												
macrophylla Pursh, var. thyrsoidea (E. Meyer) Fernald			+	+			+	+									+
bicolor L., var. concolor T. & G.										+	+	+	+	+	+	+	
Aster foliaceus Lindl.																	+
puniceus L., var. oligocephalus Fernald			+				+										
Erigeron acris L.													+	+	+		
var. droebachensis (O. F. M.) Blytt.											+	+	+		+		
var. debilis Gray													+				
hyssopifolius Michx.									+	+	+	+	+	+	+	+	
Antennaria neodioica Greene, var. gaspensis Fernald													+	+	+		
Gnaphalium supinum Villars			+	+													
norvegicum Gunner							+	+									
Achillea borealis Bongard								+							+	+	+
Artemisia borealis Pallas																	+
var. Wormskjoldii Besser																	+
canadensis Michx.									+	+	+			+	+		
Petasites vitifolia Greene							+										
trigonophylla Greene							+										
Arnica mollis Hook	+		+	+	+		+	+			+						
chionopappa Fernald											+		+		+		
gaspensis Fernald															+		
Senecio discoideus (Hook.) Britton													+	+			
pauciflorus Pursh																+	
Balsamitae Muhl.											+	+	+		+		
var. firmifolius Greenman															+		
Cirsium muticum Michx., var. monticola Fernald																	+
Taraxacum ceratophorum (Ledeb.) DC.								+					+	+	+	+	
Prenanthes Boottii (DC.) Gray	+	+	+	+	+												
trifoliolata (Cass.) Fernald, var. nana (Bigelow) Fernald	+	+	+	+	+	+	+	+									+

[1] Summits, and shores of high ponds, Adirondack Mts., New York.

[2] Summits, and shores of high ponds, higher Green Mts. (Mansfield, Camel's Hump, etc.), Vermont.

[3] Summit areas and ravines of the higher White Mts. (Washington, altitude 6300 feet — 1922 meters,— Lafayette, etc.), and shores of high ponds in the White Mts., New Hampshire.

[4] Mt. Katahdin, altitude 5270 feet (1623 meters), the highest point in Maine. For detailed account of flora see RHODORA, iii, 147–184 (1901).

[5] Lesser mountains (Baldpate, Saddleback, Abraham, Bigelow, etc.), of western and central Maine. For account of flora of Mt. Abraham see C. H. Knowlton, RHODORA, i. 191–193 (1899); of Mt. Saddleback see C. H. Knowlton, RHODORA, V. 35–38 (1903).

[6] Mt. Desert Island and adjacent islands and mainland coast, eastern Maine. See Rand & Redfield, Flora of Mt. Desert I., Me. (1894).

[7] Tableland area of Table-top Mt., a high tableland, extreme altitude 4250 feet (1296 meters), extending 15 miles or more north and south, in the western part of Gaspé Co., Quebec. Separated on the west from the Shickshock Mts. by the River Ste. Anne des Monts.

[8] Northern slopes and crests of Mt. Albert, a high tableland, extreme altitude 3900 feet (1195 meters), west of the River Ste. Anne des Monts, and forming the eastern end of the Shickshock Mt. range, in Gaspé Co., Quebec. For list of plants see John Macoun, Trans. Roy. Soc. Can. i, sec. 4, 127–136 (1883).

[9] Smuggler's Notch, a narrow pass shut in by cliff-walls of Mt. Mansfield and Sterling Mt., in northern Vermont. For detailed accounts see C. G. Pringle, Am. Nat. x. 741–743 (1876); H. W. Preston, Am. Nat. xvi. 901–905 (1882); W. W. Eggleston, Bot. Gaz. xx. 72–75 (1895); A. J. Grout, Plant World, ii. 116–118 (1899) and Torreya, ii. 46–48 (1902).

[10] Cliffs and slides on the southwest side of Willoughby Mt., Orleans Co., Vermont. For detailed account see G. G. Kennedy, RHODORA, vi. 93–134 (1904).

[11] Cliffs and ledges of the St. John River and its tributaries, northern Maine and New Brunswick.

[12] Cliffs and ledges of the Restigouche River, New Brunswick and Quebec. For account see G. U. Hay, Bull. Nat. Hist. Soc. N. B. xiv. 12–35 (1896).

[13] Cliffs and ledges of Little Cascapedia, Bonaventure, Grand, Ste. Anne des Monts, and other rivers of Gaspé and Bonaventure Counties, Quebec. For account of the flora of River Ste. Anne des Monts see John Macoun, l. c.

[14] Many cliffs and headlands (conglomerate) of Bic and adjoining towns, Rimouski Co., Quebec.

[15] Sea-cliffs and mountains from Matane River to Cape Marsouin, and at other points on the northern coast of Gaspé Co., Quebec; also Percé, Gaspé Co., Quebec. See Macoun, l. c.

[16] Narrow east and west abutments, northwest of the great tableland of Table-top Mt., Gaspé Co., Quebec. (See 7).

[17] Tableland and exposed cañon-walls, Mt. Albert, Gaspé Co., Quebec. (See 8).

In the areas of the first group — the alpine districts of the Adirondacks of New York; the exposed summits of Mt. Mansfield and Camel's Hump in Vermont; the alpine regions of the White Mts. of New Hampshire; of Baldpate, Saddleback, Abraham, Bigelow, Katahdin, and many lesser mountains of Maine; and of the tableland-area of Table-top in Gaspé; as well as the cliff-coast of eastern Maine — we find a flora many elements of which are common to all these areas, the remaining species being absent for the most part from only one or two. Of the 258 alpine and subalpine plants under consideration 70 (27.1 *per cent.*) are confined exclusively to the areas indicated as Group I (including I*a*); i. e., they are characteristic of the White Mts., Katahdin, or the tableland of Table-top, but are quite unknown from the cliffs of Willoughby or of Percé, or from the tableland of Mt. Albert. These 70 plants include such familiar species and varieties as

Hierochloe alpina.
Calamagrostis Langsdorffii.
Deschampsia atropurpurea.
Poa laxa.
Carex rariflora.
" saxatilis, var. miliaris.
Salix phylicifolia.
" argyrocarpa.
" Uva-ursi.
Salix herbacea.
Arenaria groenlandica.
Rubus Chamaemorus.
Cassiope hypnoides.
Arctostaphylos alpina.
Veronica alpina, var. unalaschcensis.
Rhinanthus oblongifolius.
Solidago Virgaurea, var. alpina.
Prenanthes Boottii.

Of the distinctive plants of the second large group of alpine and subalpine areas — Smuggler's Notch; Willoughby Cliffs; certain sea-cliffs of Bic and of the north and east coasts of Gaspé; the cliffs of certain northwestern spurs of Table-top Mt., and various river-cliffs of northern Maine, New Brunswick and the interior of the Gaspé Peninsula — there is likewise a very long list, 94 (36.4 *per cent.* of the 258 alpine plants here considered) of which are not, so far as known, ever found associated with the plants which characterize Groups I and III; while 11 others (4.3 *per cent.*) characteristic of Group II are known outside the areas comprising this group only on the north side of Mt. Albert which has already been noted as an anomalous area, Group I*a*. Among the most familiar plants of this large flora (Group II) are

Cryptogramma Stelleri.
Asplenium viride.
Woodsia alpina.
" glabella.
Carex eburnea.
Anemone multifida.
" parviflora.
Draba stylaris.
Saxifraga oppositifolia.
" Aizoön.

Saxifraga aizoides.
Parnassia Kotzebuei.
Dryas integrifolia.
" Drummondii.
Astragalus elegans.
" Blakei.
Hedysarum boreale.
Shepherdia canadensis.
Primula farinosa, var. macropoda.
" mistassinica.
Gentiana Amarella, var. acuta.
Pinguicula vulgaris.
Erigeron hyssopifolius.
Artemisia canadensis.

Although only 27 of these 105 (94 + 11) species characteristic of Group II occur on Willoughby Cliffs and 23 of them on the cliffs of Smuggler's Notch, 102 of the 105 are found on the cliffs of eastern Quebec where they are the characteristic vegetation.

The great tableland and cañon-walls of Mt. Albert, although exposing many square miles of alpine region, have a comparatively meagre flora; but the few species which there abound are of the greatest interest to the eastern botanist, for with but few exceptions they are quite unknown upon any other mountains or cliffs in eastern North America. The plants which are strictly localized in the rock-crevices and on the talus-slopes of Mt. Albert make up, so far as yet determined, a flora of only 21 species (8.15 *per cent.* of the 258 alpine and subalpine plants) but this flora includes the very distinctive

Adiantum pedatum, var. aleuticum.
Cryptogramma densa.
Polystichum scopulinum.
Deschampsia caespitosa, var. alpina.
Danthonia intermedia.
Festuca altaica.
Salix desertorum.
" chlorolepis.
Lychnis alpina.
Arenaria ciliata, var. humifusa.
" sajanensis.
" arctica.
Statice sibirica.
Solidago decumbens.
Artemisia borealis.
" " var. Wormskioldii.
Cirsium muticum, var. monticola.

The area indicated as Group I*a*, the northern slopes and crests of Mt. Albert, while supporting many plants (26) otherwise confined to areas of Group I and several (11) otherwise known only from areas of Group II, has by itself a scarcely noteworthy flora, only 5 plants (1.9 *per cent.* of our alpine species). These plants — *Carex lagopina*, *Luzula spicata*, var. *tenella*, *Sagina saginoides*, *Ranunculus pygmaeus* and *R. Allenii* — are all technical species and varieties and it is not improbable that further exploration will show them to belong primarily to either Group I or II.

The plants referred to in the preceding paragraphs represent a considerable proportion of our alpine and subalpine species and strongly marked varieties which, when they grow upon exposed summits and slopes and cold cliffs, are confined very definitely to certain

isolated localities but are quite absent from many closely adjacent alpine and subalpine areas in which the conditions of exposure, extremes of temperature, and amount of precipitation are seemingly the same. Besides the three primary groups of plants which, south of the St. Lawrence, are confined each to a single mountain or to certain very definite mountains and cliffs, there are several secondary groups of alpine species which are found associated with the members of each of two of the primary groups but not the third; and a rather smaller group of species which show no apparent selection of alpine areas. That is to say, a few plants grow in equal abundance on Mt. Washington, Katahdin, or Table-top (Group I) and on the tableland of Mt. Albert (Group III); others occur on the tableland of Mt. Albert (Group III) and also on the cliffs of Smuggler's Notch, or of the lower St. Lawrence, or on the northwestern abutments of Table-top Mt. (Group II); while only a few species thrive in all these areas (Groups I, II, and III). These facts will perhaps be more clearly brought out by the following summary.

Table II.

Summary of the known Distribution south of the St. Lawrence of 258 Alpine and Subalpine Plants above enumerated, showing the Number occurring in the various Groups of Areas.

	Group.	Species.	Per cent.
Confined to a single group	I	65	25.2
	Ia	5	1.9
	II	94	36.4
	III	21	8.15
Occurring on two or more groups	I & II	12	4.65
	Ia & II	11	4.3
	I & III	32	12.4
	Ia & III	0	0
	II & III	4	1.55
	Ia, II & III	2	0.8
	I, Ia, II & III	12	4.65
		258	100.00

Of the species which abound on Mt. Washington, Katahdin, or Table-top (Group I) and on the tableland of Mt. Albert (Group III) as well, but are unknown on the coastal cliffs of Gaspé and in other areas with an essentially identical flora (Group II) there are 32 (12.4 *per cent.*), of which the following are noteworthy.

Lycopodium Selago, var. appressum.
Carex canescens.
" rigida, var. Bigelowii.
Juncus trifidus.
Betula glandulosa.
Silene acaulis.
Rubus arcticus.
Empetrum nigrum.
Ledum groenlandicum.
Rhododendron lapponicum.
Loiseleuria procumbens.
Kalmia angustifolia.
" polifolia.
Phyllodoce caerulea.
Andromeda glaucophylla.
Vaccinium uliginosum.
" canadense.
" Vitis-Idaea, var. minus.
Diapensia lapponica.
Prenanthes trifoliolata, var. nana.

Twelve other plants (4.6 *per cent.*) unknown from the tableland of Mt. Albert (Group III) are common to districts included in Groups I and II; 11 species (4.3 *per cent.*) are common to Groups I*a* and II, but are unknown from Groups I and III; 4 (1.5 *per cent.*) are common to Groups II and III; and 2 only (0.8 *per cent.*), absent from areas of Group I proper, are known from Groups I*a*, II and III.

Twelve species (4.65 *per cent.*) are common to all the areas. These noteworthy plants are all familiar species:

Larix laricina.
Picea mariana.
" canadensis.
Abies balsamea.
Agrostis borealis.
Carex brunnescens.
" scirpoidea.
Luzula parviflora.
Rubus triflorus.
Potentilla tridentata.
Castilleja pallida, var. septentrionalis.
Viburnum pauciflorum.

It is apparent from this analysis of our alpine floras that, of the 258 plants here enumerated, 185 species and varieties (65 + 5 + 94 + 21) or 71.65 *per cent.* are closely restricted in their occurrence south of the St. Lawrence each to only one of the groups of mountains, cliffs, and alpine areas above tabulated; 61 (12 + 11 + 32 + 4 + 2) or 23.7 *per cent.* are known from two of the primary groups but not the third; and only 12 or 4.65 *per cent.* are found on all three groups of mountains and cliffs. Obviously, with less than 5 *per cent.* of our alpine and subalpine plants showing an inclination to grow upon all our mountain areas, but with more than 95 *per cent.* of the species showing a decided preference either for one group of alpine areas or for two of the groups

but not the third, there is to be found in the characteristics of these areas some influence or group of influences which is of fundamental importance in the distribution of plants.

If we seek in the precipitation and exposure of such districts as the tableland of Table-top Mt. (Group I), the northwestern escarpments of Table-top (Group II), and the tableland of Mt. Albert (Group III), an explanation of the very dissimilar floras of these areas we shall find that, as we should expect, these closely adjacent slopes and summits (the northwestern escarpments and the western edge of Table-top only about ten miles east of the tableland of Albert) have no apparent difference in the amount of precipitation. Nor is the exposure of these cloud-enshrouded districts a significant factor. The flat tableland of Mt. Albert, for instance, and its cañon-valleys with walls facing north, south, east, and west support an essentially uniform flora; similarly, upon Table-top a uniform flora is found upon north, south, east, and west exposures as well as upon the level portions of the tableland. Precipitation and exposure are, then, of only minor importance in determining the localized distribution of our alpine plants.

In attempting to account for the peculiarities of plant distribution much stress has been laid of late upon the degree of fineness or coarseness of soils, and their water-content. But to those intimate with the occurrence of our alpine plants these factors, again, seem of secondary importance. For instance, *Cystopteris montana* on Mt. Albert grows in equal abundance on the firm and steep amphibolite cliffs and in the deep, fine and saturated alluvium of mountain streams. *Selaginella selaginoides*, abundant in the wet mossy bogs of Bonaventure and Gaspé Counties, Quebec, is quite as much at home in the well-drained alpine meadows or in the crevices of either wet or dry rocks, in the latter situation merely becoming stiffer and more stocky than in deep shade or moisture. *Zygadenus chloranthus* is apparently indifferent whether it is in the crevices of sun-baked rock, on cold cliffs, in river-alluvium or in wet bogs. Similarly, many other members of the flora characteristic of the areas classed as Group II grow in wet or dry, fine or coarse soils.

The distinctive plants of Groups I and III, likewise, show a remarkable indifference to the coarseness or fineness, the dryness or saturation of their supporting soils. *Empetrum nigrum*, *Ledum groenlandicum*, *Vaccinium Vitis-Idaea*, var. *minus*, and *Prenanthes trifoliolata*,

var. *nana*, for example, seem equally at home in crevices of sun-baked or spray-showered rock, on sandy plains, in well-drained alpine meadows, and in saturated sphagnum bogs. With our alpine plants so ubiquitous, then, in their occurrence, upon saturated, well-drained, or dry soils, and with an apparent ability to thrive equally well in fine river alluvium or in the crevices of a scarcely altered ledge or cliff, we are hardly justified in depending upon these factors to explain the distribution indicated in the preceding tabulation.

When, on the other hand, we examine the lithological character of the regions in which these plants occur we find a very striking coincidence between the soil-forming rocks of these mountains and cliffs and the distribution of the plants which cover them.

In the first group of alpine areas specially indicated — the great mass of the White Mountains of New Hampshire; the Adirondack Mountains of New York; the highest summits of the Green Mountains of Vermont; Baldpate, Saddleback, Abraham, Bigelow, Katahdin, and nearly all the other naked-topped mountains of Maine; the great tableland of Table-top Mountain in Gaspé; and Mt. Desert Island and other parts of the exposed eastern coast of Maine — the predominant and often the exclusive rocks are granite or gneiss (both containing much orthoclase or potash-feldspar, and generally muscovite or potash-mica) or mica (muscovite)-schist,[1] often in close proximity, and all especially high in potassium. The distinctive soil element of the alpine areas constituting Group I is, then, potassium; and on these mountains and cliffs peculiarly rich in potassic constituents we find 122 of the plants here discussed, nearly two-thirds of which in their alpine distribution are quite unknown on the mountains of Groups II and III.

When, however, we examine the second large group of alpine and subalpine areas we shall find that their characteristic rocks differ from those of the first group — the mountains characterized by granite, gneiss, and mica-schist, rocks which furnished a strongly potassic soil — in one constant point. The cliffs of Percé,[2] of the

[1] For valuable assistance in the determination of several characteristic rock-specimens from eastern Quebec the writer is under special obligations to Professor J. E. Wolff and his student, Mr. H. N. Eaton. Upon these determinations and the detailed reports of members of the Geological Survey of Canada the writer has chiefly depended for the lithological data in this article. He is also indebted for suggestions upon the soil constituents of many rocks to Mr. H. H. Bartlett of the Gray Herbarium.

[2] For details of the mountains and cliffs of Percé see J. M. Clarke, N. Y. State Mus., Rep. lvii. 1. pt. 1 (Bull. 80), 133–171 (1905).

north coast of the Gaspé Peninsula,[1] and of Bic [2] are chiefly limestones, calcareous sandstones, limestone-conglomerates, and calcareous slates; the northwestern escarpments of Table-top Mt., where *Salix vestita* and *S. glauca*, *Saxifraga oppositifolia*, *S. Aizoon* and *S. aizoides*, and *Primula mistassinica* abound, are limestones;[3] the river-cliffs and ledges of many streams of eastern Quebec, northern New Brunswick and Maine, characterized by *Cryptogramma Stelleri*, *Asplenium viride*, *Woodsia alpina* and *W. glabella*, *Carex eburnea*, *Tofieldia glutinosa*, *Astragalus elegans*, *Hedysarum boreale*, *Shepherdia canadensis*, *Primula mistassinica*, *Pinguicula vulgaris*, *Erigeron hyssopifolius*, etc., are chiefly limestones and limy slates (Silurian),[4] or frequently some other rock penetrated by veins of calcite; the famous cliffs at Willoughby where the most notable plants occur are of impure limestone;[5] and the great cliffs of Smuggler's Notch, unknown personally to the writer, are said by those who are familiar with them to show

[1] "On the south side of the St. Lawrence, in the counties of Gaspé and Rimouski, the rocks of the Quebec group are unconformably overlaid by a series of calcareous strata, which we have been accustomed to call the Gaspé limestones."—Logan, Geology of Canada, 390 (1863). For further details see Logan, l. c. 390–453; also Ells, Geol. Surv. Can., Rep. of Progress for 1880–81 and –82, part D D (1883).

[2] "In the vicinity of Bic Harbour there is a great display of the limestone conglomerates and the associated calcareous sandstones of groups B [Lower Silurian conglomerate limestones], and it is to the resistance which they have offered to the destroying agencies that have worn away the other rocks of the coast, that the formation of Bic Harbour is due.....In the limestone conglomerates the masses inclosed are sometimes very large; a boulder of dark gray limestone inclosed in one of the bands at Metis was measured and computed to weigh twelve tons; another in another part of probably the same band measured eleven feet long by six feet broad, and was supposed to weigh upward of twenty-five tons."— Richardson, Geol. Surv. Can., Rep. of Progr. for 1858, pp. 149, 150 (1859). Mr. H. N. Eaton's microscopical examination of rock-samples collected by the writer from two of the Bic headlands showed the limestone and other pebbles and boulders to be held together by a calcareous cement.

[3] "Along the east and west flanks of Table-top Mountain, beds of dark-grey limestone are seen which upon careful examination showed no trace of fossils, but which, on account of their resemblance to the Levis limestones of the coast, described in former reports, and their position in relation to these rocks, are thought to be of the same age [Cambrian].

They appear to have been lifted up by the great granite mass which forms the main portion of Table-top Mountain, and for some distance from their contact with this mass, they show signs of alteration, being more or less changed to a dark-grey marble. The country occupied by these rocks is very mountainous. The ridges run east and west, seemingly along the general strike of the rocks, and are cut by numerous brooks on both sides of the water-shed, distant about six miles from the coast, and between it and the Ste. Anne River.

The mountains have rounded outlines, and are well wooded, although in the vicinity of Table-top they rise to a height of three thousand feet above the sea level, the general height being about fifteen hundred feet."— Low, Geol. Surv. Can., Rep. for 1882–83–84, pt. F. 15 (1884).

[4] See Logan, Geol. of Canada (1863); J. W. Dawson, Acadian Geol. (1878); etc.

[5] See Kennedy, Rhodora, vi. 94, 95 (1904).

distinct incrustations of lime, especially in the sheltered pockets which are the hiding-places of *Cryptogramma Stelleri.* The soils of the second primary group of alpine areas are, then, distinctly calcareous; and on the calcareous mountains and cliffs we find 135 of the species here under consideration,[1] 94 of which are apparently unknown upon the little-calcareous but strongly potassic rocks (Group I) and upon the tableland area of Mt. Albert which constitutes Group III.

This third primary division of our alpine districts, the tableland of Mt. Albert, has long been distinguished among the mountains of Gaspé as an extensive area of serpentine, a soft rock which is essentially a hydrated magnesium silicate. The analysis of typical serpentine as given by Dana is "silica 43.48, magnesia 43.48, water 13.04 = 100,"[2] though extensive areas of massive serpentine do not reach this standard of purity. The distinctive soil-element, then, in the third primary division of our alpine areas is magnesium. Now, the presence in a soil of so large an amount of magnesian compounds and the absence of appreciable amounts of potassium and calcium produce conditions exceedingly unfavorable to the majority of plants; and the vast serpentine area of Mt. Albert appears to the unbotanical visitor essentially destitute of vegetation. This impression of the area was well described by Dr. A. P. Low, the discriminating Director of the Geological Survey of Canada, who in the summer of 1883 spent some weeks in a study of the geology of the Shickshock Mts. and of Table-top Mt. Mr. Low says: "The top of Mt. Albert is nearly flat, and is rent by a deep gorge on the east side, which, near its head, splits into several smaller ones. The sides of these gorges are quite destitute of vegetation and the bare serpentine rocks are weathered to a light buff color. On the top of the mountain blocks of serpentine are scattered around, and are partially covered by a thick growth of mosses [chiefly *Racomitrium lanuginosum*] and lichens. Sheltered places are occupied by a stunted growth of black spruce (*Abies nigra*), which rarely attains a height of ten feet. The branches interlace near the ground and form an impenetrable thicket. The whole surface has a dead appearance, and reminds one of the pictures of the moon."[3]

This vivid impression of the serpentine area of Mt. Albert is gained

[1] In Europe many species have been pointed out as confined primarily to calcareous soils. For a bibliography on this subject see Schimper, Pflanzen-Geogr. 129, 130 (1898).

[2] Dana, Man. Geol., ed. 4, 68 (1895).

[3] Low, Geol. Surv. Can., Rep. for 1882–83–84, pt. F. 7, 8 (1884).

by all who visit it, yet upon its seemingly naked slopes, in the crevices of the rock, and among the decomposing boulders, many plants are spread which in the first grand view of the region make little appeal to the eye. As already seen, 21 alpine plants are, so far as known, found south of the St. Lawrence only on the serpentine of Mt. Albert. Other species whose identity is still in doubt carry the number of these distinctive plants well toward forty. Several species also (32), unknown upon the strongly calcareous cliffs and mountains, but abounding on the slopes characterized by potassic rocks — *Betula glandulosa, Empetrum nigrum, Rhododendron lapponicum, Vaccinium uliginosum,* etc.— are equally abundant on the serpentine; 6 others,— *Selaginella selaginoides, Cerastium arvense, Arenaria verna,* var. *propinqua,* etc.,— are common to the limy rocks and the serpentine; and 12 species are found growing in many stations upon all three groups of mountains. It is, however, important to note that, while the coniferous trees occur as luxuriant forest upon the north slope of Mt. Albert nearly to the summit, reaching an altitude of 3300 feet (1000 meters), and form extensive forests on the high tableland at 3500 to 4000 feet (1050 to 1215 meters) of Table-top Mt.; they are on the serpentine of Mt. Albert only as scattered and uncharacteristic dwarf trees and shrubs, and no forest of appreciable character is seen in the area above the level of Ruisseau à la Neige at an altitude of about 1900 feet (570 meters), where the forest consists of meagre and valueless Bog Spruce (*Picea mariana*). In its meagre appearance the Bog Spruce on the serpentine of Mt. Albert is paralleled by *Rhododendron lapponicum, Vaccinium uliginosum, Ledum groenlandicum,* and other species, which, having their great development on potassic rocks, are on the serpentine of Mt. Albert very dwarfed and of a starved aspect. The more distinctive plants of the mountain, however,— *Adiantum pedatum,* var. *aleuticum, Polystichum scopulinum, Festuca altaica, Lychnis alpina, Arenaria arctica, Statice sibirica, Artemisia borealis,* etc.— are, especially in damp hollows or along water-courses, luxuriant to a surprising degree; the stipes of the *Adiantum* often exceeding a foot in length, the fronds of the *Polystichum* eighteen inches long, the handsome clumps of *Festuca* with culms two to three feet high, and *Artemisia borealis,* ordinarily only a few inches high, attaining in its var. *Wormskioldii* a height of twelve or fifteen inches, with wand-like inflorescences eight inches in length. From these observations it is concluded that, of the large group of plants which abound upon the

potassic rocks, a few are able to grow, under protest as it were, upon the strongly magnesian soil of Mt. Albert; but that another group of plants, unknown upon our granitic, gneissic, and schistose mountains or on the strongly calcareous mountains and cliffs, are not only restricted to the strongly magnesian rocks, but there attain a normal and often a luxuriant development.[1]

It will be remembered that on the northern edge of Mt. Albert (Group I*a*) two groups of plants are found; some species ordinarily confined to the potassic rocks (feldspathic or micaceous), others generally known only from the strongly calcareous soils. Different sections of the northern and eastern slopes of the mountain examined by Mr. Low showed the rock of the upper or subalpine and alpine district to be chiefly hornblende-schist and amphibolite, with occasional large areas of impure limestone, chloritic slates and schists; and gneiss, made up chiefly of orthoclase (potash-feldspar) and hornblende;[2] and as indicated by rock-specimens kindly examined microscopically

[1] It is interesting, in view of the great abundance on the serpentine of Mt. Albert of *Cerastium arvense*, to note that in 1887 Drs. Hollick and Britton called attention to the fact that on Staten Island *C. arvense*, var. *oblongifolium* "grows abundantly at many places on the serpentine hills, and in no other parts of the Island"; and that an analysis of the ash of the Staten Island plant showed it to contain

"Silica (SiO_2)	39.85
Alumina and Oxide of Iron (Al_2O_3 and Fe_2O_3)	18.58
Lime (CaO)	9.35
Magnesia (MgO)	19.79"

See Hollick & Britton, Bull. Torr. Cl. xiv. 45–50 (1887).

This is a remarkable amount of magnesia to be present in a plant, the average plants of mixed soils deriving from the soil much less magnesia (See Dana, Man. ed. 4, 74).

As a rock plant, *Cerastium arvense* is rare in Maine, only one station, on the rocks between Cape Cottage and the light-house at Cape Elizabeth, being known personally to the writer; and, according to Hitchcock "Cape Elizabeth is largely composed of talcose schist [hydrous silicate of magnesium]"— C. H. Hitchcock, Agr. and Geol. Me., Ser. 2, 1861, p. 162 (1861). It will be noticed that in the tables of distribution *Cerastium arvense* is entered in Group I only from the eastern coast of Maine. The stations are few, the Duck Islands, etc., and it is not improbable that the plant is there on magnesian soil, for Hitchcock records talcose schist and serpentine as largely present along the coast of Penobscot Bay and on some of the neighboring islands. (Hitchcock, l. c., 162–163).

Several other plants of low altitudes have been recorded as occurring primarily on magnesian soils, but as yet such data in regard to North American plants is unfortunately rare.

In Europe, two much-discussed ferns, *Asplenium adulterinum* Milde and *A. Adiantum nigrum*, subsp. *serpentini* (Tausch) Heufler, are clearly demonstrated to grow only on serpentine, and on that rock to take the places respectively of *A. viride*, which prefers calcareous rocks, and *A. Adiantum nigrum* (typical), which is commonly on silicious soils. —For discussion see Luerssen, Farnpfl. 165–184, 275–281 (1889), also Schimper, Pflanzen-Geogr. 103, 104 (1898).

[2] Low, Geol. Surv. Can., Rep. for 1882–83–84, pt. F. 17, 18 (1884).

for the writer by Mr. H. N. Eaton, the amphibolite of the northern slope shows, besides hornblende and talc (a silicate of magnesium), calcite (carbonate of lime) and a lime-soda feldspar.[1] In the soil of this slope, then, potassium and calcium are found in such proportion, apparently, as to account for the presence of a few species each of the plants (24 of the potassic rocks, 11 of the calcareous) which ordinarily are found only on soils high in one or the other of these two elements.

But the chief interest of the north slope of Mt. Albert is in the fact that by far the most abundant mineral in the rocks is hornblende, which has as its principal constituents silica, magnesia, protoxide of iron, and lime.[2] Yet, so far as observed, none of the distinctive plants of the serpentine (magnesian) area of Mt. Albert extend across to the hornblende (also magnesian) area. This is obviously due to the hardness and slow decomposition of the hornblende as opposed to the softness and rapid decomposition of the serpentine, but detailed chemical analyses of the soils and plant-ashes, now under way, by Mr. H. H. Bartlett, will, when completed, furnish more satisfactory conclusions as to the exact conditions. Similarly, many questions somewhat outside the intended scope of the present preliminary paper have presented themselves for solution, but before they can be appropriately discussed they must await more detailed field-study and the completion of many chemical analyses.

The foregoing discussion, however, of the relation of our alpine plants to the chief soil-constituents of the rocks upon which they grow, establishes very conclusively the fact that the alpine plants are much more dependent upon the chemical constituents of the soil than has been generally supposed.

[1] Mr. Eaton's analysis of this rock from the north crest of Mt. Albert is as follows:

"A heavy, black schistose rock containing hornblende and feldspar.

In thin section — a holocrystalline rock, composed of hornblende, plagioclase, and talc. The hornblende constitutes the great bulk of the rock. It is very pleochoric — light yellow, grass green, and greenish blue. Some crystals are idiomorphic, while others are eaten into and show intergrowths with feldspar and calcite.

Feldspar is relatively abundant in allotriomorphic prisms. It is wholly plagioclase. Twinning according to both the carlsbad and albite laws is common. The albite striations make angles of 9, 19, and 36 degrees respectively on three crystals which were tested; proving the species to have a range between a mixture of oligoclase and andesine, through andesine, to basic labradorite.

Talc occurs abundantly in irregular masses between the hornblende crystals, and seems to be a product of hornblende decomposition.

The rock is an amphibolite."

[2] Dana, Man. Geol. ed. 4, 67 (1894).

Unfortunately, the data accompanying herbarium-specimens rarely indicates anything of the soil-characters of the habitats of plants; and, besides, these facts are not easily gained from extensive geological maps. Yet, if we examine the sheets issued by the Geological Survey of Canada, we shall find that in their range outside the areas specially under consideration the plants which we have been discussing show a selection of soils similar to that already pointed out. A few illustrations will make this point more clear.

Empetrum nigrum, the Crow-berry or Curlew-berry, it will be remembered, is one of the commonest plants of the granitic, gneissic, and schistose mountains and coastal rocks of northern New England, New York, and eastern Canada. Outside of this area it abounds on the eastern coast of Newfoundland, throughout the Labrador Peninsula, in Baffin Land and Greenland, and more or less across the Arctic; "along the north shore of Lake Superior, and at Port Arthur.... Thence it takes a northwesterly direction and is found in peat bogs, on exposed rocks along lake shores, and on barren grounds to the Pacific Ocean and Arctic Sea."[1] From the Arctic it extends southward along the Coast Range to the region of Sitka; it is on the mountains of southern British Columbia, and very locally at isolated alpine or coastal stations southward. Many other characteristic plants of the eastern potassic rocks — *Loiseleuria procumbens, Vaccinium uliginosum, V. Vitis-Idaea*, var. *minus, Rubus Chamaemorus*, etc.— follow essentially this distribution and are unknown or of the greatest rarity along the Rocky Mountains. Others, however, such as *Sibbaldia procumbens*, are on the highest peaks of the Rocky Mountain system as well. Another group of these species is well represented by *Vaccinium ovalifolium* which, common on the potassic rocks of Gaspé, is unknown in the Arctic regions and the Rocky Mountains; but occurs from the Aleutian Islands to the mountains of Oregon, also in northern Michigan and in Newfoundland and southern Labrador. Still another group, represented by *Arenaria groenlandica*, is confined to Greenland, Labrador, the north shore of the St. Lawrence, the summit of Table-top, the coast of Nova Scotia near Halifax, the coast of Maine from the Mt. Desert region to the mouth of the Kennebec, the mountain-summits of northern New England and New York, a bleak granite slope below Middletown, Connecticut, and a few iso-

[1] Macoun, Cat. Can. Pl. i. 458 (1886)

lated summits to the highest peaks of the Carolinas. Various minor modifications of these ranges might be given, but these are sufficient to indicate the general distribution of these plants which in New England, New York, and eastern Canada are confined to granite, gneiss, and mica-schist.

Now, if we examine the lithological character of these areas in which *Empetrum nigrum*, *Sibbaldia procumbens*, *Vaccinium ovalifolium*, and *Arenaria groenlandica* abound, we shall find that these plants are commonly on potassic rocks. Thus, as shown by a geological map of Canada, the ancient Archaean area occupies nearly the whole district from Labrador to Lake Superior and the Lake of the Woods, its western boundary thence swinging northwestward to Lake Winnipeg, westward and northward to Lake Athabasca, Great Slave Lake, and then north to the Arctic.[1] This great area is primarily of gneiss, granites and mica-schist, rocks, it will be remembered, which are markedly potassic; and the area of its great development, it will be noted, is strikingly coincident with the general range assigned by Professor Macoun to *Empetrum nigrum*, a plant which in Labrador is reported by Low as "abundant throughout the semi-barren and barren regions of the peninsula, growing freely on the coast and inland,"[2] and by Delabarre as "the most abundant phenogamous plant of Labrador."[3] *Empetrum*, it will be remembered, extends along the Coast Range from the Arctic to the region of Sitka, and locally southward. It is also on the mountains of southern British Columbia, but absent from the general Rocky Mountain area. When we again examine the geological map of Canada, we find that the entire Coast Range is designated as "Coast Granite," and that most of the southern part of British Columbia (immediately north of Washington) is granitic. Similarly, in the Rocky Mountains, where *Sibbaldia procumbens* and some other plants of these potassic rocks occur, the Archaean rocks form the "backbone" of the mountains; and in northern Michigan, where *Vaccinium ovalifolium* is found, and along the crests of the Alleghanies, where *Arenaria groenlandica* occurs, we have isolated southern extensions of the great Archaean axis which is best developed from Labrador to Lake Superior and northwestward.[4]

[1] The boundaries of this Archaean V-shaped mass are very distinctly shown in Dana's Manual, ed. 4, fig. 494. Note there also the isolated areas of Archaean.

[2] Low, Geol. Surv. Can., Ann. Rep. n. s., viii. pt. L. 40 (1896).

[3] Delabarre, Bull. Geogr. Soc. Phil. iii. 190 (1902).

[4] See Dana, l. c.

Furthermore, in the Maritime Provinces of Canada in which we know only a single station for *Arenaria groenlandica* (on rocks near Halifax), granite is of only occasional occurrence; in fact it is quite unknown on the coast between Nova Scotia and the north shore of the St. Lawrence. In Nova Scotia, however, there are some isolated granitic areas, one of the largest extending from Halifax Harbor to Margaret's Bay,[1] the only coastal station for *Arenaria groenlandica* in Canada south of the St. Lawrence. Likewise, at the only station in Connecticut for *Arenaria groenlandica*, the plant is said by its discoverer to grow "on bleak granite rocks below the city [Middletown]."[2]

When, however, we examine the broad range of plants which in New England and eastern Canada are confined to strongly calcareous rocks, we find that they have a distribution quite different in some details from those just examined. The range of *Dryas Drummondii* — on the limy rocks and gravels of the Gaspé Peninsula, on Anticosti, and generally along the rivers of the Canadian Rockies — has been noted. Many other plants show a similar range. Now, as indicated on the recent geological map of western Canada, the general area occupied by the Canadian Rocky Mountains is called Palaeozoic, a general classification to cover much of the area indicated on a previous map merely as "limestone"; and in his Journal of a Boat Voyage through Rupert's Land and the Arctic Sea, Sir John Richardson mentions *Dryas Drummondii, Hedysarum boreale, Elaeagnus argentea, Shepherdia canadensis*, and several other plants of our calcareous cliffs and gravels as abounding on the limestones of the Mackenzie River.[3] Other plants of our limestone mountains and cliffs occur at somewhat scattered stations in Newfoundland, Labrador, and Arctic America; and a few of the plants, which south of the St. Lawrence are confined to the magnesian soils of Mt. Albert, are also known at isolated points from Newfoundland northward.

In order to test, so far as it is possible to do so without more accurate

[1] See Geological map of Nova Scotia, New Brunswick and Prince Edward Island, by J. W. Dawson, in Acadian Geology (1878).

[2] H. L. Osborn in letter to Asa Gray, May 17, 1878.

[3] "The dogwood, silvery opulaster (*Elaeagnus argentea*), *Shepherdia*, and *Amelanchier* grow on banks that in Europe would be covered with gorse and broom, and the southern *Salix candida* is replaced by the more luxuriant and much handsomer *Salix speciosa*, which is the prince of the willow family. The *Hedysarum Mackenzii* and *boreale* flower freely among the boulders that cover the clayey beaches; while the showy yellow flowers and handsome foliage of the *Dryas Drummondii* cover the limestone debris."— Richardson, Arct. Searching Exped. 123 (1852).

data than exists upon herbarium-labels, the conclusions above reached, the writer has listed all the stations known to him, either from specimens or authentic reports, in arctic and subarctic British America, for fifteen of the more typical plants of the alpine districts of New England, New York and eastern Canada. In this work he has been greatly assisted by the map of Arctic British America and the accompanying notes published by Dr. G. M. Dawson.* In order to make the test more valuable the fifteen plants whose ranges were thus studied were selected equally from those of the three groups above tabulated. All together 55 stations or definite regions for these fifteen plants have been found. Of these, 7 are either not indicated on available maps or are too vaguely stated on the labels to be of service. The remaining 48 stations are listed in the following tabulation, and in each case the rock of the region, which could furnish the soil-elements for which the plants show distinct preferences in New York, New England, and eastern Canada, is noted.

TABLE III.

SHOWING THE KNOWN STATIONS OR REGIONS, FROM NEWFOUNDLAND TO ARCTIC BRITISH AMERICA, FOR 15 ALPINE PLANTS OF NEW YORK, NEW ENGLAND AND EASTERN CANADA.

GROUP I (Plants which, south of the St. Lawrence, are controlled in their Distribution by a Preponderance of Potassium in the Soil.) Stations, and Rocks of the Region from which Potassic Soils could be derived.	Eriophorum callitrix	Carex rariflora	Arenaria groenlandica	Rubus Chamaemorus	Empetrum nigrum
Cape Ray and Channel to White Bay, Newfoundland (Archaean [1])				+	+
Despair Bay to Fogo Island, etc., Newfoundland (Archaean [1])	+		+	+	+
Southeastern Newfoundland (Archaean [1])	+			+	+
Baie Ste. Claire, Pointe-Ouest, etc., Anticosti (granite, gneiss[2])	+			+	+
North shore of St. Lawrence from Cap à l'Aigle to Bradore Bay, Quebec (granite, gneiss [3])	+	+	+	+	+
Red Bay, Labrador (gneiss [4])	+				+
Sandwich Bay, Labrador (syenite [5])			+		
St. Lewis Inlet, Labrador (syenite, gneiss [6])		+		+	

* Geol. and Nat. Hist. Surv. Can., Ann. Rep. n. s., ii. pt. R (1887).

TABLE III —*continued.*

Group I (Plants which, south of the St. Lawrence, are controlled in their Distribution by a Preponderance of Potassium in the Soil.) Stations, and Rocks of the Region from which Potassic Soils could be derived.	Eriophorum callitrix	Carex rariflora	Arenaria groenlandica	Rubus Chamaemorus	Empetrum nigrum
Seal Island, Labrador (gneiss [7])				+	
Webeck Harbor, Labrador (gneiss, syenite [8])		+			
Hopedale, Labrador (gneiss, granite [9])	+	+	+	+	+
Paul's Island, Labrador (gneiss [10])	+		+		+
Nain, Labrador (gneiss [11])	+	+		+	+
Hebron, Labrador (gneiss [12])	+			+	
Ungava Bay, Cape Chudleigh, Labrador (gneiss [13]) . . .	+	+		+	
Cumberland Sound, Baffin Land (gneiss, granite [14]) . . .	+				
Nottingham Island, Hudson Strait (gneiss, syenite [15]) . .	+			+	+
Cape Prince of Wales and Ashe's Inlet, or North Bluff, Hudson Strait (gneiss [16])				+	
Richmond Gulf, Ungava (feldspathic argillite, gneiss, etc.[17])	+				
Great Whale River, Ungava (gneiss [18])	+				
Lake Mistassini, North East Territory (gneiss [19])	+	+			
Fort Churchill, Hudson Bay (felspathic arkose, etc.[20]) . . .				+	+
Chesterfield Inlet, Hudson Bay (granite, gneiss [21])				+	+
Great Bear Lake, Mackenzie (granite, gneiss [22])		+			
Fort Resolution, Great Slave Lake, Mackenzie (granite [23]) .				+	
Athabasca Plains, Athabasca (granite and gneiss [24]) . . .				+	+

[1] Dana indicates a "central Newfoundland range" of Archaean, and "two other ranges farther east," the only one shown on his map running from Despair Bay northeastward to Fogo Island region. On Logan's map in the Atlas accompanying the Geology of Canada (1863) the southeastern district of Newfoundland is also indicated as chiefly Archaean.

[2] "Cette soi-disant forêt sur laquelle on marche. . . .se trouve en quelques endroites de la côte, comme à la Pointe-Ouest, par example. Là, la végétation se présente, en effet, sous l' aspect d' un tapis serré de plantes basses (*Arctostaphylos Uva-Ursi, Vaccinium Vitis-Idaea, Vaccinium pennsylvanicum, Ribes oxyacanthoides, Empetrum nigrum,* etc.), formé en outre de tous petits sapins et d'épicéas tourmentés. . . .Cette plateforme nous montre ici une succession de lits minces de calcaires argileux le plus souvent peu fossilifères. Notre promenade ayant lieu pendant la basse mer, nous rencontrons des blocs erratiques, parfois nombreux et groupés dans de petites anses, parfois isolés, çà et là, et sur lesquels nous reviendrons à propos de la période quaternaire. Presque tous ces blocs sont formé de roches cristallines (granit, gneiss, anorthosite, etc.)"— Schmitt, Monographie de l' Ile d' Anticosti, 11, 70 (1904).

[3] "With the exception of a narrow border of Silurian strata on the Strait of Belle Isle, another at the mouth of the Mingan River, and a third near the Seven Islands, with the addition of two narrow Silurian strips running a few miles up the Murray River and the Gouffre, the north shore of the St. Lawrence is the southern boundary of this ancient series of deposits [Laurentian, chiefly granites and gneisses] from Labrador to Cape Tourmente"— Logan, Geol. Can. 47 (1863).

[4] "Looking up through the bays and harbors we can see the low conical hills of Laurentian gneiss"— Packard, Lab. Coast, 281 (1891).

[5] "The Laurentian rocks [at Sandwich Bay] rise into high, rugged, and broken syenitic hummocks."— Packard, l. c. 281 (1891).

[6] "We pass St. Lewis Bay . . . .with its north shore evidently syenitic . . . .the headlands of syenite probably extend out from the gneiss mainland."— Packard, l. c. 137 (1891).

[7] "At Seal Island the 'Domino gneiss' of Lieber appears, protected seaward by high islands intermixed with low gneiss 'skiers'."— Packard, l. c. 158 (1901).

[8] "Cape Webuc or Harrison, which is a lofty gneiss headland, faced with syenite."— Packard, l. c. 181 (1901).

[9] "The island on which Hopedale is situated is of the ordinary Laurentian gneiss which behind the mission house is curiously contorted; it is fine-grained, distinctly banded, with veins of quartz and of granite."— Packard, l. c. 206 (1901).

[10] "On going ashore at Ford's Harbour [Paul's Island], I found the gneiss to consist of common reddish and greyish varieties."—Bell, Geol. and Nat. Hist. Surv. Can., Rep. of Progr. for 1882–83–84, p. 11 DD (1884).

[11] "The rock here [Nain] consists of a rather light grey gneiss."— Bell, l. c. 12 DD.

[12] "At this mission station [Hebron], the rocks were examined and found to be common biotite gneiss and amphibolites, intersected by trap dykes."— Daly, Bull. Mus. Comp. Zool., Harvard, Geol. Ser. V. no. 5, 216 (1902).

[13] "The rock everywhere [Ungava Bay at Port Burwell] consists of ordinary varieties of gneiss."— Bell, l. c. 18 DD (1901).

[14] "Dr. Boas describes the nucleus of the mountain masses [Baffin Land] as everywhere gneiss and granite."— G. M. Dawson, Geol Surv. Can., Ann. Rep. n. s. ii. 40 R (1887).

[15] "I explored the country [Nottingham Island] to a distance of about three miles in various directions from our anchorage, and found the rocks to consist of common varieties of gneiss, the only exception noticed being patches of a fine-grained red syenite on both sides of the inlet." — Bell, l. c. 28 DD (1901).

[16] "The rocks on the west side of Ashe's Inlet consist of dark grey gneiss, composed principally of quartz and felspar in even beds. . . . The rocks in the vicinity of the bay [Stupart's Bay, Prince of Wales Sound] were found to consist entirely of Laurentian gneiss."— Bell, l. c. 21, 25, DD (1901).

[17] "It [Richmond Gulf] is surrounded by high hills. On the west, sharp cliffs, formed by the broken faces of the Manitonieck rocks [felspathic argillites], which dip toward the sea, rise in places twelve hundred feet above the water. The south and east sides are bounded by lower rounded hills of Laurentian and Huronian rocks."— Low, Geol. Surv. Can., Ann. Rep. n. s., iii. 55 J (1888).

[18] "At the fifteen foot chute [Great Whale River] the rock is similar to the last, and from here to the mouth of the river all the exposures examined were made up of red and grey hornblende orthoclase gneiss, the red predominating."— Low, l. c. 54 J (1888).

[19] "The greater part of the shore-line here [west side of Lake Mistassini] being formed of gneiss, perpendicular faces are wanting."— Low, l. c. viii. 68 L (1896).

[20] "The rock [at Port Churchill] is a greenish-gray even-grained, false-bedded, felspathic arkose sandstone."— Tyrrell, Geol. Surv. Can., Ann. Rep. n. s. ix. 90 F (1897).

[21] "Granites and gneisses occur along the north shore of Baker Lake, and down both shores of Chesterfield Inlet to its mouth."— Tyrrell, l. c. ix. 169 F (1897).

[22] "The rocks of the southeast extremity of McTavish Bay [southeastern arm of Great Bear Lake] are described as red granites and gneisses."— G. M. Dawson, l. c. 19.

[23] "Near the easternmost [channel of Slave River], which is named John's River (*Rivière à Jean*), is Stony Island, a naked mass of granite, rising fifty or sixty feet above the water; and beyond that, to the eastward, the banks of the lake [Great Slave Lake] are wholly primitive."— Richardson, Arct. Searching Exped. 97 (1852).

[24] "They [Laurentian rocks] occupy most of the northern shores of Athabasca and Black Lakes. Throughout the greater portion of the area, the rock consists of light reddish-gray hornblende-granite, and biotite-granite or granitoid gneiss."— Tyrrell, l. c. viii. 16 D (1896).

"In the *second* or *barren ground* district, in places where the soil is formed of the coarse sandy *debris* of granite. . . .*Rhododendron lapponicum, Kalmia glauca* [*polifolia*], *Vaccinium uliginosum, Empetrum nigrum, Ledum palustre, Arbutus* [*Arctostaphylos*] *Uva ursi, Andromeda* [*Cassiope*] *tetragona*, and several depressed or creeping willows, lie close to the soil."— Richardson, l. c. 416 (1852).

TABLE III—*continued.*

GROUP II (Plants which, south of the St. Lawrence, are controlled in their Distribution by a Preponderance of Calcium in the Soil.) Stations, and Rocks of the Region from which Calcareous Soils could be derived.	Anemone parviflora	Saxifraga caespitosa	Saxifraga oppositifolia	Dryas integrifolia	Pinguicula vulgaris
Bay of Islands to Cape Norman, Newfoundland (limestone [1])	+			+	+
Anticosti (limestone [2])	+	+	+	+	+
Mingan Islands, Quebec (limestone [3])					+
Forteau Bay, Labrador (limestone [4])		+		+	+
Chateau Bay, Labrador (basalt, trap [5])		+			+
Battle Harbor, Labrador (trap, etc.? [6])		+	+	+	+
Indian Harbor, Labrador (doleritic trap containing labradorite [7])					+
Hopedale, Labrador (doleritic trap, labradorite [8])	+	+		+	+
Paul's Island and Nain, Labrador (labradorite, gabbro, anorthosite [9])	+	+	+	+	+
Kaumajet Mts., Okkak to Cape Mugford, Labrador (diabase, limestone [10])			+	+	+
Torngat Mts., Hebron to Nachvak Bay, Labrador (diabase, limestone, calcspar [11])	+	+	+	+	+
Ungava Bay, Cape Chudleigh, Labrador (dolomite, limestone [12])		+		+	+
Grinnell Land (limestone [13])		+		+	
Cape Sabine, Smith Sound (limestone [13])		+	+		
Jones Sound, Ellesmere Land (limestone [14])			+	+	
Cumberland Sound, Baffin Land (Middle Laurentian rocks? [15])			+	+	
Cape Prince of Wales and Ashe's Inlet, or North Bluff, Hudson Strait (dolomite, limestones, calcspar [16])		+	+	+	
Mansfield Island, Hudson Bay (limestone [17])		+	+		
Foot of James Bay, Moose Factory to Rupert House (limestone [18])	+			+	+
Fort Churchill, Hudson Bay (limestones [19])				+	+
Melville Island (limestone, calcareous sandstone [20]) . . .		+	+	+	
Fort Good Hope, Mackenzie River (limestone [21])				+	+
Great Slave Lake, Mackenzie (limestone [22])					+

[1] "On the opposite side [of the Strait of Belle Isle], the shore of Newfoundland is occupied by a series of limestones, apparently of Calciferous age. . . . they stretch along the coast for upwards of a hundred miles."— Logan, Geol. Can. 288 (1863).

These and other limestones are traced in succeeding pages and shown in the accompanying Atlas southward to Bay St. George.

[2] Anticosti Island is composed of Silurian rocks, chiefly limestones, which are discussed in detail in Logan's Geology of Canada, Chapters x and xii. See also Schmitt, Monographie de l' Ile d' Anticosti, 65–99 (1904). In view of a very general impression that *Sphagnum* does not occur in calcareous regions and of its abundance in certain marly bogs of Gaspé Co., Quebec (see RHODORA, vii, 8), it is interesting to note the statement of Sir William Logan that "the most extensive peat deposits in Canada are found on Anticosti. Along the low lands on the south coast of the island, from Heath Point to within eight or nine miles of Southwest Point, a continuous plain covered with peat

extends for upwards of eighty miles, with an average breadth of two miles; thus giving a superficies of more than one hundred and sixty square miles. The thickness of the peat, as observed on the coast, was from three to ten feet."— Logan, l. c. 783, 784 (1863).

3 "It is not until reaching the Mingan Islands, between 500 and 600 miles to the northeastward, that we have any of its [Calciferous formation] characteristic fossils. . . . At the Mingan Islands and on the neighboring coast, there appears an interesting extension of this formation extending from Mingan River to Ste. Geneviève Island, a distance of about forty-five miles. It occupies the inner range of islands and most of the coast."— Logan, l. c. 119 (1863).

4 "Between this exposure [Mingan Islands] and Bradore Bay, the distance is about 300 miles. The shore, which is very much indented by bays and inlets, and fringed with a multitude of islands, presents an almost continuous line of bare rock; but in no part of it have there been observed any strata, but such as belong to the Laurentian series. On the east side of Bradore Bay, which is situated near to the entrance to the Straits of Belle Isle from the Gulf of St. Lawrence, the palaeozoic rocks again present themselves. Resting on the Laurentian gneiss, they run along the north coast for nearly eighty miles, with a breadth of probably ten or twelve miles. . . . On the strike, these yellow-weathering limestones pass in some parts into grey, compact, pure limestone. . . . In Forteau Bay, the whole mass appears to be more or less fossiliferous."— Logan, l. c. 287, 288 (1863).

5 "At Henley Harbor [Chateau Bay] is a system of trap-rocks. . . . These rocks consist of three masses of columnar basalt, capping the syenitic gneiss. It is a hard, fine, compact dolerite. . . . West of these basaltic rocks, on the opposite side of the harbor, is a large trap overflow forming a hill over three hundred feet high."— Packard, Lab. Coast, 285, 286 (1891).

6 I am unable to find any specific statement in regard to Battle Harbor, which is situated between Chateau Bay (5) and the great anorthosite area of St. Michael Bay.

7 "At Indian Harbor. . . . these same rocks ['Domino Gneisses'] appear. . . . Invariably accompanying these rocks is a doleritic trap of a peculiar mineralogical character. . . . It is composed of large crystalline masses of hypersthene and labradorite [a lime-soda feldspar]"— Packard, l. c. 288, 289 (1891).

8 "About an hour before we reached Hopedale, we passed a high sugar-loaf-shaped island 'The Beacon'. . . . The rock was evidently that variety of syenite containing labradorite [a lime-soda feldspar] and green hornblende."—Packard, l. c. 197. Trap dykes (doleritic) like those at Chateau Bay were seen at Hopedale, "in places like slightly winding stairs or steps descending to the water's edge, justifying the term *trap* applied to this rock, which is from the Swedish *trappa*, meaning a series of steps or stairs."— Packard, l. c., 206, 286 (1891).

9 "The Hopedale gneiss underlies the eastern end of Paul's Island, but a few miles west of Ford Harbor, it comes in contact with the famous anorthosite [a lime feldspar] and allied gabbro whence is derived the schillerizing labradorite. . . . The 'Brave' was headed for Nain, passing through a long tickle walled in on either side by high cliffs of massive gabbro for fifteen miles. . . . all the mainland visible thereabouts is composed of the gabbro."— Daly, Bull. Mus. Comp. Zool., Harvard, Geol. Ser. v. no. 5, 216–218 (1902).

10 At Mugford, "next above the light colored zone of the schists comes a series of black slates fifty to one hundred feet thick, indurated at the contact by a conformable three hundred-foot sheet of apparently intrusive diabase [containing labradorite]. . . . On Ogua'lik at the southwest end of the Tickle, the gneisses are overlain by an intrusive sheet of diabase, about fifty feet in thickness, upon which are piled slates, quartzites, limestones, and sandstones with interbedded traps."— Daly, l. c. 220, 221 (1902).

11 Daly (l. c. 225, 226) discusses the sedimentary and intrusive rocks of this range, which are similar to those of the Kaumajet Mts. See also Bell, Geol. and Nat. Hist. Surv. Can., Rep. for 1882–83–84, 15 DD, etc. (1884).

"On the west shore of the first cove, from the entrance, on the south side of Nachvak inlet, the rocks consist of a coarse-grained slaty tufa or breccia. . . . to the south of it is a coarse grey mica schist. . . . In this rock, and near the slaty breccia, a vein of quartz was found, from a foot to two feet in thickness, and holding patches of brown-weathering calcspar."— Bell, l. c. 15, 16 (1884).

[12] "A short distance south of the station, a vein, varying from 8 to 13 inches in width, occurs in the gneiss.... It consists of light grey dolomite [calcium-magnesium carbonate] and white quartz.... Fragments of grey, drab and yellowish limestone, with obscure fossils, were common around the base of the hill."— Bell, l. c. 18, 19 (1884).

[13] Dr. G. M. Dawson, quoting from a paper of Fielden and De Rance, says: "A limestone formation, resembling that elsewhere so widely spread in the Arctic regions, is described as characterizing considerable tracts on both the east and west sides of Kennedy Channel and Smith's Sound.... Carboniferous limestones were recognized in several places along the north coast of Grinnell Land.... 'There would also appear to be a strong likelihood that the limestone continues in a southeasterly direction by way of these mountains [the United States range] across the whole of Grinnell Land'."— G. M. Dawson, Ann. Rep. Geol. Surv. Can., n. s., ii. 51, 52 R (1887).

[14] As indicated by Dawson little is known of the rocks of Ellesmere Land. The "Cape Rawson Beds" [containing limestones], however, are known there.

[15] "The southern part of Baffin Land, including Frobisher Bay and Cumberland Sound together with Melville Peninsula, may be particularly referred to as evidently exhibiting a considerable development of Middle Laurentian rocks [including crystalline limestones]."— Dawson, l. c. 7.

[16] "Among the prevailing gneiss boulders, scattered on the hills and plains, were found several of grey dolomite.... A small piece of greyish crystalline limestone was picked up near Ashe's Inlet.... Here [Eskimo Inlet, Prince of Wales Sound] I found a good many boulders of grey and yellowish limestone on the beach.... One of the veins of white quartz in this locality contains purplish red calcspar,.... resembling some of the banded crystalline limestones of the Laurentian series."— Bell, l. c. 22–27.

[17] "We arrived at the eastern part of Mansfield Island, about mid-way down, on the morning of the 30th of August. Its even outline presented a remarkable contrast to the shores of Hudson's Strait. It resembled a gigantic ridge of gravel; but stratified rocks, in low horizontal ledges, appeared here and there, through the *debris*, at different levels.... I landed at a point about the middle of the eastern shore of the island, and found the shore very flat, with shallow water for a considerable distance out. The rock proved to be a fossiliferous grey limestone, in rather thin horizontal beds."— Bell, l. c. 33.

[18] "To the west and south it [shore at foot of James Bay] is almost flat, with its soil overlying nearly horizontal beds of Silurian and Devonian limestones for about one hundred and fifty miles inland to the Archaean country."— Low, Ann. Rep. Geol. Surv. Can., n. s. iii. 16 J (1888).

[19] "In a fissure [at Port Churchill].... is, or was, a small outlier of an unaltered Cambro-Silurian limestone.... With the above are associated some fragments of white Silurian limestone.... In and around the old fort at the mouth of the river, are many boulders of heavier-bedded Trenton limestone."— Tyrrell, Ann. Rep. Geol. Surv. Can., n. s. ix. 91 F (1897)

[20] "The surface of it [Table-hill, Melville Island] consists generally of sand, on which are lying numerous masses of limestone.... We had passed, during our last march, a good deal of rich soil.... and the sorrel and saxifrage (*Saxifraga oppositifolia*) were more abundant than before.... On the north side of this ravine large masses of sandstone were lying on the surface of the ground,.... and we remarked on this, and several other occasions, that the stones which were bruised by the wheels emitted a strong odor, like that of fetid limestone when broken."— Parry, First Voyage, Journal, 177, 184–85 (1821).

[21] "At night we camped not far from the Old Fort [Good Hope]. The shale, sandstone, and limestone beds, continue throughout the space intervening between the former and present sites of Fort Good Hope."— Richardson, Arct. Searching Exped., 135 (1852).

[22] "In the vicinity of the westernmost channel of the delta [of Slave River] and from thence to the efflux of the Mackenzie, the whole southern shore of the lake is limestone"— Richardson, l. c. 97.

TABLE III—*continued.*

Group III (Plants which, south of the St. Lawrence, are controlled in their Distribution by a Preponderance of Magnesium in the Soil.) Stations, and Rocks of the Region from which Magnesian Soils could be derived.	Lychnis alpina	Arenaria arctica	Arenaria sajanensis	Statice sibirica (and perhaps others)	Artemisia borealis
Coal River, Newfoundland (serpentine [1])	+	+		+	
Hopedale Islands, Labrador (trap [2])	+	+		+	+
Paul's Island, Labrador (gabbro, pyroxene [3])	+			+	+
Nain, Labrador (gabbro [3])	+	+		+	+
Kaumajet Mts., Okkak to Cape Mugford, Labrador (basalt, lavas [4])			+	+	+
Torngat Mts., Hebron to Nachvak Bay, Labrador (black diorite, soapstone [5])	+		+	+	+
Ungava Bay, Cape Chudleigh, Labrador (dolomite [6]) . . .	+			+	
Cape Prince of Wales and Ashe's Inlet, or North Bluff, Hudson Strait (dolomite, black mica, soapstone [7])		+		+	
Nottingham Island, Hudson Strait (dolomite [8])			+	+	

[1] On Bonne Bay, "there rises to a height of between 2000 and 3000 feet, a mountain of serpentine."— Logan, Geol. Can. 293 (1863). These serpentine mountains, as shown on the geological map of Canada, are greatly developed southward to Port au Port Bay. Coal River has its origin upon one of them, and its lower waters flow through another of the serpentine areas.

[2] "Trap dykes were always in the view [Islands off Hopedale]."— Daly, Bull. Mus. Comp. Zool., Harvard, Geol. Ser. v. no. 5, p. 216 (1902).

[3] "The 'Brave' was headed for Nain, passing through a long tickle walled in on either side by high cliffs of massive gabbro."— Daly, l. c. 217. "When at Nain I obtained specimens of. . . .paulite, a variety of pyroxene or hypersthene [a silicate of magnesium], which. . . .was said to have been brought from Paul's Island."— Bell, Geol. & Nat. Hist. Surv. Can., Rep. for 1882–83–84, p. 12 DD (1884).

[4] "The basalt [containing crysolite, a silicate of magnesium] agglomerate, which is also a significant part of the stratified series, is typical."— Daly, l. c. 221.

"Ogua'lik, Cape Mugford, the Bishop's Mitre are all part of an extensive area of slates, sandstones, conglomerates, limestones, and, much surpassing these in thickness, lava flows, volcanic tufts, and breccias."— Daly, Bull. Geogr. Soc. Phila. iii. 208 (1902).

[5] "Some dykes of close-grained, almost black diorite [black diorite usually contains much augite, a silicate of magnesium], also cut the gneiss in the vicinity of Skynner's Cove. . . .I was informed that the Eskimo obtained a kind of soapstone [a hydrous silicate of magnesium] for making their pots. in the vicinity of Skynner's Cove. . . . dykes [of black-looking rock] were seen all along, cutting the face of the mountain range." — Bell, l. c. 15 DD.

[6] "A short distance south of the station [at Port Burwell, Cape Chudleigh], a vein. . . . occurs in the gneiss. . . .It consists of light grey dolomite [magnesian limestone] and white quartz" — Bell, l. c. 18 DD.

[7] "Scattered on the hills and plains [near North Bluff, Hudson Strait], were several [boulders] of grey dolomite....and of the soft buff grey dolomite."— Bell, l. c. 22 DD. "On the west side of Ashe's Inlet....some of them [veins] contain feldspar and black mica [magnesian]."— Bell, l. c. 29 DD. "At Ashe's Inlet a party of Eskimo from the eastward came on board." Among the rocks shown them "they recognized a rather hard and inferior variety of soapstone,"— Bell, l. c. 21, 24, 25 D D.

[8] "At a projecting point....I found some straggling veins of hard grey dolomite."— Bell, l c. 29 D D.

It is not, of course, possible from the inadequate data at hand to say with certainty that in their arctic and subarctic distribution in British America the fifteen plants just discussed are confined to or even occur upon the soils which have respectively a preponderance of potassium, calcium, or magnesium; but it is clear that in the northern regions from which these plants are known soils are present similar to those upon which the plants have their best development south of the St. Lawrence. In their southern stations, however, it is apparent that the plants of alpine situations here considered show in most cases a pronounced selection of habitats dependent upon the relative abundance in the soil of the three important food-elements, potassium, calcium, and magnesium. A very similar selection of soils is shown by many plants of low altitudes; in fact, it is possible thus to analyze the distribution of the majority of *Pteridophyta* and *Spermatophyta* of New England and eastern Canada. It is very generally known, for instance, that many heaths (*Kalmia, Rhododendron, Vaccinium,* etc.) occur primarily on potassic soils; and that they are rare or quite unknown in extensive areas of limestone and can there be cultivated with success only if provided with an imported soil free from the abundant lime of the region.[1] Many other plants of low altitudes or of temperate regions, *Camptosorus rhizophyllus, Pellaea atropurpurea, Carex eburnea,* etc., are best developed on if not confined to calcareous rocks. These plants of low altitudes, *Kalmia latifolia, Rhododendron canadense* (*Rhodora*), *R. maximum, Vaccinium pennsylvanicum, Camptosorus, Pellaea atropurpurea, Carex eburnea,* etc., restricted in their best development to somewhat specialized soils and ordinarily absent

[1] "Any open, well-drained soil which does not contain limestone or heavy clay and has a moist and fresh subsoil will prove satisfactory [for Rhododendrons]. Where limestone or heavy clay prevails, beds must be specially prepared and filled with suitable soil."— A. Rehder, in Bailey, Cycl. Am. Hort. 1516, 1517 (1902).

"It is generally conceded that lime soils and manures containing lime . . . . are injurious to Rhododendrons; in limestone regions it is undoubtedly advisable to substitute, for the natural soil, others which are free from this objectionable element."— B. M. Watson in Bailey, l. c. 1519.

from certain others, occupy, in a general way, wide areas in eastern America; and, though absent from certain localities, they may be said to have a far more continuous range than the alpine species, and the intervals between their more isolated outlying colonies are not too great to be crossed by seeds and spores in the ordinary processes of dispersal.

The alpine plants, on the other hand, are, as already noted, present in our flora usually as small colonies isolated by hundreds or even thousands of miles from the other known members of their species. *Dryas Drummondii*, for example, one of the most abundant plants of the Canadian Rockies, has its nearest known colonies 2000 miles away, along the rivers of the Gaspé Peninsula and of Anticosti. *Polystichum scopulinum*, abundant on steep serpentine walls of Mt. Albert, Gaspé, is otherwise confined to mountains from Idaho to northern California, at least 2200 miles away. *Festuca altaica*, the commonest grass of Mt. Albert, is otherwise known only from Yukon, 2700 miles to the northwest, and from the mountains of Asia. Other species, though very isolated in their occurrence, are found at one or more points between our New England and Gaspé mountains and the northwestern portion of the continent. Among such is *Vaccinium ovalifolium* whose range has been already stated. These plants, typical of our alpine and subalpine species, often occur, then, in such isolated areas that it is highly improbable that they should have reached their known localities by ordinary dispersal of seeds and spores from one of these areas directly to another. And, in view of the fact above pointed out, of the restriction on adjacent alpine areas of most of our alpine plants to prevailingly potassic, calcareous, or magnesian soils, it is at first difficult to see how these extremely fastidious plants could have grown in close association at the close of the glacial period, as implied by the long-accepted theory of Forbes, which was greatly extended by Darwin, Hooker, Gray, and others.

When, however, we take into account the character of some exceptional stations for these alpine plants at low altitudes or in less pronouncedly cliff- or rock-habitats, we get a clue to the conditions which they presumably found in their poleward march in the wake of the receding ice-sheet. Throughout New England and adjacent Canada and over much of the continent westward and northwestward there are many cold meadows and bogs or muskeags in which the conditions are such as to support many species which abound in alpine

or high-northern regions. In hundreds of bogs of New England and eastern Canada we find a few of the less markedly alpine plants such as *Carex pauciflora, Eriophorum callitrix, Habenaria dilatata, Andromeda glaucophylla, Ledum groenlandicum,* etc., plants which are typical of our sphagnous bogs and of the mountains composed of potassic rocks. Certain bogs and meadows maintain floras of greater variety and of very great interest, especially when we take into account the alpine distribution exhibited by them. Caribou bog, in Crystal, Maine, for instance, has, besides *Drosera linearis, Betula pumila, Lonicera oblongifolia,* and many other plants of unusual occurrence in New England, a few arctic-alpine species:

Eriophorum callitrix (Group I)
Carex vaginata (Group II)
" paupercula, var. irrigua (Groups I & III)
" limosa (Groups I & III)
" pauciflora (Group I)
Tofieldia glutinosa (Group II)
Rhamnus alnifolia (Group II)
Ledum groenlandicum (Groups I & III)
Rhododendron canadense (Group I)
Kalmia angustifolia (Groups I & III)
" polifolia (Groups I & III)
Andromeda glaucophylla (Groups I & III)
Menyanthes trifoliata (Group I)
Lobelia Kalmii (Group II)
Erigeron acris (Group II)

Small bogs at the mouth of the Grand River, Gaspé Co., and similar but larger bogs at the mouth of the Bonaventure River, Bonaventure Co., Quebec, situated in strongly calcareous regions, have a notable series of arctic-alpine plants, of which the following are conspicuous:

Selaginella selaginoides (Groups II & III)
Scirpus pauciflorus (Group II)
" caespitosus (Groups I & III, and rarely II)
Rynchospora capillacea (Group II)
Carex vaginata (Group II)
" paupercula, var. irrigua (Groups I & III)
" limosa (Groups I & III)
Juncus filiformis (Group I)
Tofieldia glutinosa (Group II)
Salix pseudo-myrsinites (Group II)
" balsamifera (Group I)
" pedicellaris (Group I)
Comandra livida (Groups I & III)
Parnassia parviflora (Group II)
Rubus arcticus (Groups I & III)
Potentilla palustris (Group I)
Empetrum nigrum (Groups I & III)
Rhamnus alnifolia (Group II)
Viola nephrophylla (Group II)
Ledum groenlandicum (Groups I & III)
Andromeda glaucophylla (Groups I & III)
Chamaedaphne calyculata (Groups I & III)
Vaccinium canadense (Groups I & III)
" Vitis-Idaea, var. minus (Groups I & III)

Vaccinium Oxycoccus (Groups I & III)
Menyanthes trifoliata (Group I)
Euphrasia latifolia (Group II)
Pinguicula vulgaris (Group II)
Lonicera caerulea, var. villosa (Groups I & III)
Lobelia Kalmii (Group II)

A certain boggy meadow in a sag near the western edge of Tabletop Mt. is, perhaps, the most notable of these bog-areas. This particular meadow, which lies southeast of the crest of the limy northwestern escarpment upon whose cliffs are found many of the plants of Group II, is so situated as to receive the drainage from various directions. From the northwest the drainage is directly off the calcareous slope and in part from a granitic slope; from the southwest comes a general seepage from a small area of serpentine; and from the southward the drainage is off the edge of the great granitic tableland. On account of the strong contrast between the flora of this small meadow and the extensive meadows of the strictly granitic district, the area was designated by Professor Collins and the writer "the Calcareous Meadow," and it has been so indicated upon many herbarium labels. Yet the flora of this notable meadow contains many plants besides those of the calcareous alpine cliffs. The detailed list of alpine plants there recorded includes the following:

Selaginella selaginoides (Groups II & III)
Polystichum Lonchitis (Group II)
Phleum alpinum (Groups I & II)
Agrostis borealis (Groups I, II, & III)
Deschampsia atropurpurea (Group I)
Danthonia intermedia (Group III)
Scirpus caespitosus (Groups, I, II, & III)
Carex stellulata (Group I)
" deflexa (Group I)
" capillaris, var. elongata (Group II)
" atrata, var. ovata (Groups I, II, & III)
Juncus castaneus (Group II)
Habenaria dilatata (Groups I & III)
Salix vestita (Group II)
" Barclayi (Group II)
" pseudo-myrsinites (Group II)
" argyrocarpa (Group I)
" glauca (Group II)
" phylicifolia (Group I)
Betula glandulosa (Groups I & III)
Alnus crispa (Groups I & II)
Comandra livida (Groups I & III)
Anemone parviflora (Group II)
Arabis alpina (Group II)
Rubus arcticus (Groups I & III)
" triflorus (Groups I, II, & III)
Pyrola grandiflora (Group II)
Phyllodoce caerulea (Groups I & III)
Vaccinium uliginosum (Groups I & III)
" caespitosum (Group I and rarely II)
" ovalifolium (Group I)
Veronica alpina, var. unalaschcensis (Group I)
Castilleja pallida, var. septentrionalis (Groups I, II, & III)
Rhinanthus oblongifolius (Group I)
Viburnum pauciflorum (Groups I, II, & III)
Lonicera caerulea, var. villosa (Groups I & III)
Valeriana sylvatica (Group II)

Solidago multiradiata (Groups II & III)
Aster foliaceus (Group III)
Erigeron hyssopifolius (Group II)
Gnaphalium norvegicum (Group I)
Achillea borealis (Groups II & III)
Petasites trigonophylla (Group I)
Arnica mollis (Groups I & II)
Senecio pauciflorus (Group II)
Cirsium muticum, var. monticola (Group III)
Taraxacum ceratophorum (Group II)
Prenanthes trifoliolata, var. nana (Groups I & III)

On these bogs and meadows, it will be noticed, there is a decided mingling of the plants which on alpine rocky slopes or on cliffs are rarely if ever found associated.

Similarly, in the valleys of rivers flowing from our higher mountain areas fragments or seeds of alpine plants are washed down to the bottom-lands where there results a mingling of the plants which are ordinarily confined to distinct areas and soils. Thus, along the River Ste. Anne des Monts, which receives much of the drainage from Mt. Albert, Table-top, and the adjacent mountains, we find, on the broad alluvial "flats" which are submerged during the freshet periods, such plants as *Vaccinium ovalifolium* (Group I), *V. Vitis-Idaea*, var. *minus* (Groups I & III), *Lychnis alpina* (Group III), *Epilobium alpinum* (Group I), and *Deschampsia caespitosa*, var. *alpina* (Group III) growing side by side and in equal luxuriance with *Arabis alpina, Dryas Drummondii, Erigeron hyssopifolius, Senecio discoideus, Taraxacum ceratophorum*, and other plants which in their rock-habitats are confined primarily to areas of Group II.

These series of habitats, the meadows, bogs, and alluvial plains, are alike, it will be seen, in having an extremely fine and mixed soil, often derived from rocks of very different kinds; and it is, apparently, the availability in these soils of the potassium, calcium, and often the magnesium, which makes it possible for plants, which in less favored soils are restricted to rocks high in one or another of these elements, to grow side by side on the bogs, meadows, and alluvial plains. Now, if we consider the condition of much of the northern hemisphere during the period when the great ice-sheet was receding and the arctic and subarctic plants were following in its wake, we shall see that there were, in America for instance, measureless stretches of country, from Long Island Sound northward, westward and northwestward and again on the western slopes of the continent, which were essentially identical in their character with the bogs and meadows above referred to, while there also abounded far greater deposits

of mixed and water-worn "till" than now cover large portions of our region. On these vast areas of fine and mixed soils nearly if not quite all the polar and boreal species could find the food-element or the combinations of elements upon which they most depended. For, even if the newly deposited soil in a given region were derived primarily from a single rock or from two rocks, a limestone and a serpentine for instance, it would require the presence in the region of only a very small quantity of another rock, a potassic feldspar for example, to support during their northward march the plants which require a potassic soil, as well as those which depend upon an abundance of calcium or magnesium. A very vivid illustration of this fact is contained in a recent paper by Mr. Allerton S. Cushman on "The Use of Feldspathic Rocks as Fertilizers."[1] Mr. Cushman says:

"Grinding is making surface, and it can be shown that the availability of potash in ground feldspar increases with the surface area. If feldspar is ground so that it will pass an 80-mesh sieve, it will of course contain a certain proportion of very fine particles, some of which approach the limits of visibility under a powerful microscope. If we carry on the grinding of the material from 80-mesh to 200-mesh, the proportion of the very small particles is enormously increased. The smallest particles which we need to consider here are those which can be measured by a micrometer device connected with the microscope. These smallest particles have a diameter of about 0.0001 millimeter. Now, in order to make a specific example, we will consider the surface areas presented by 1 pound of feldspar in different degrees of subdivision. First, in the form of a solid cube, then broken down to particles that could just pass an 80- and a 200-mesh sieve, respectively, and, finally, in the condition it would be if it were possible to grind all the material as fine as the finest particles which occur in an ordinary 200-mesh powder. The 1 pound of feldspar in a solid cube would have a surface area of 29.3 square inches; particles capable of passing an 80-mesh seive would give 8,870 square inches; particles able to pass a 200-mesh sieve would give 24,905 square inches; and if it were possible to reduce the powder to particles 0.0001 millimeter in diameter, there would result a surface area of 16,460,000 square inches.

If it were practically possible to collect 1 ton of feldspar all in the

[1] U. S. Dept. Agric., Bur. Pl. Ind., Bull. no. 104 (1907).

state of the finest particles, as shown above, the surface-area presented by the ton would be enormous — in fact, it would be equal to 256,000,000 square feet, 5,877 acres, or more than 9 square miles."[1]

It is quite conceivable, then, that the polar plants, which had been forced to find temporary homes on the potassic, calcareous, or magnesian areas or the mixed soils of our more southern states and in Mexico, found in the extensive alluvial deposits, which, after the receding of the ice, covered much of the northern half of our continent, a mixed soil in which they were able to spread both eastward and westward as well as poleward; and then, as the particular soil-element upon which they most depended gradually became exhausted from the mixed soil and as the climate at low altitudes became increasingly warmer, these plants found upon bogs, cold meadows or sheltered alluvial shores, or upon cold cliffs and exposed mountain summits, the only habitats in which they have been able to persist within our temperate regions.

In areas of conglomerate rocks, it should be added, as for instance on some of the conglomerate cliffs along the lower St. Lawrence, where the component pebbles are of varied origin (limestones, serpentine, feldspathic rocks, etc.), there is sometimes a mixture of floras similar to that found on the bogs or meadows, and such plants as *Empetrum* and *Hedysarum* or *Zygadenus* will be found occasionally on the same cliffs. In such mixed areas it is, of course, difficult without actual examination of the soil and analyses of the ash of the plants, such as are now being made by Mr. H. H. Bartlett, to determine the controlling soil-elements.

Similarly, in the mixed soils which cover the ordinarily tillable districts of our northern states and Canada the problem is complicated, and in these temperate areas the preference of certain plants for one soil or another is best seen in rock- and cliff-habitats. There is need of close observations along these lines, and, although, in the alpine and subalpine areas here chiefly considered, the distribution of plants is largely controlled by the preponderance in the soil of potassium, calcium and magnesium, it will be found that in various areas, sodium, iron, and other elements are of equal importance in determining the ranges of our plants.

[1] Cushman, l. c. 27, 28.

Peridermium pyriforme and its probable alternate host.

J. C. Arthur.

Early in June of this year I received from Dr. Charles Thom a specimen of *Peridermium pyriforme* Peck, collected near Storrs, Conn., on branches of *Pinus rigida* Mill. This is a species rarely seen, only three previous collections being known,[1] and its discovery in a locality where it can be under observation and study is a matter of interest. The species forms numerous and conspicuous aecia on the smaller branches, bursting out through the bark, and showing as large white peridia filled with orange spores. The affected branches are not much swollen by the fungus, and are usually small, less than 2.5 cm., rarely up to 5 cm. in diameter.

So far as known, all species of *Peridermium* on the bark of pines are the aecial stages of corresponding forms of *Cronartium*. Upon the receipt of Dr. Thom's collection the question of the probable telial host presented itself. In the eastern United States only two species of *Cronartium* have so far been recognized: *C. Quercus* (Brond.) Schroet., and *C. Comptoniae* Arth. In the same general region there are also two bark forms of *Peridermium* on pine: *P. Cerebrum* Peck, and *P. pyriforme* Peck. It has been proven by means of cultures, performed independently by Dr. C. L. Shear and the writer, that *P. Cerebrum* is the aecial stage of *C. Quercus*, and it was a simple inference that *P. pyriforme* doubtless belongs to *C. Comptoniae.*

While this information was being communicated to Dr. Thom, the spores which he had sent, and which were not yet dry, were sown on *Myrica cerifera*, a plant of *Comptonia* in good growing condition not being available at the time. No infection was obtained by this sowing. This negative result is without much significance, however, as no examination was made to see if the spores germinated.

The next observations on the rust in the field were made July 5, when Dr. Thom found *Comptonia peregrina*, growing "all around the bases" of the affected pine trees, showing abundance of the characteristic uredinia of *Cronartium Comptoniae*. The spores of the *Peridermium*

[1] See Bull. Torrey Club xxxiii. 420 (1906), where the history of these collections is given.

had now largely disappeared. Both at this time and at the earlier visit on June 4 no examples of the *Peridermium* were found more than 3 dm. above the ground, and the infection was mostly on very small trees, or on small branches near the ground.

The three previous collections of this *Peridermium* were also on small branches. Two of them were made by Mr. J. B. Ellis at Newfield, N. J., one in 1882 on *Pinus virginiana* Mill., distributed in his N. Am. Fungi *no.* 1021, and the other in 1890 on *P. rigida* Mill. The third collection has little import, as it was made in the Missouri Botanical Garden, and if it really belongs to this species, was doubtless brought to the Garden on plants obtained in the eastern states. The rust on *Comptonia* is common in the region about Newfield, N. J.

Of the common forms of *Aecidium* and *Roestelia* many have been definitely associated with their corresponding telial forms. But of the twenty-seven known species of *Peridermium* in North America, which number doubtless represents not more than half the full number that exists, only three have yet been connected by cultures with their telial forms, hence one element of interest in the observations of Dr. Thom. The publication of this note is intended to supply the clue to any one who may be fortunately situated, and inclined to undertake cultures of this rust, which can best be made during the month of May.

Purdue University, Lafayette, Indiana.

The Record of Color Varieties of Gratiola at Westfield, a clerical Error.— On page 123 of the current volume of Rhodora it was stated that the white and light yellow forms of *Gratiola aurea* had been found at Westfield, Massachusetts. Miss Emily F. Fletcher has called our attention to the fact that this was probably a clerical error and that the station where the plants were found was in reality Westford, which is in Middlesex County, and not Westfield as stated. Reference to Dame & Collins's Flora of Middlesex County, Massachusetts, shows that Miss Fletcher is quite right and that in fact the station was Westford and not Westfield as quoted through some oversight.—Ed.

A Pink-petaled Form of Clethra alnifolia.— Several years ago I found on the edge of Watuppa Lake, Fall River, Massa-

chusetts, one bush of *Clethra alnifolia* with pink petals. It was growing in company with a dozen or more bushes of the same species which had the ordinary white petals. Every year since it was first observed the pink-flowered individual has blossomed true to its color. Some seasons it has been badly killed back by the winter; but in all cases shoots from the root have exhibited the pink petals when they have flowered. Finding in the botanical works accessible to me no mention of a pink-flowered variety of this species I sent specimens to the Gray Herbarium where further literature was consulted but no reference to this variation of color was found. As most, if not all, works on our flora, which mention *Clethra*, state that its flowers are white, it seems worth while to put on record this attractive exception.— Louise Holmes Handy, Fall River, Massachusetts.

The Bulletin of the Josselyn Botanical Society of Maine.— At the thirteenth annual meeting of the Josselyn Society, held at Oxford, Maine, from the 2nd to the 5th of July, the committee on publications reported as follows: "Recommended, that the Society issue a sheet called the Bulletin of the Josselyn Botanical Society of Maine; that the frequency of its issue be determined by the publication committee; that the publication contain an abstract of the minutes of the Society, with a list of the plants collected or identified at the meeting, and such other matter of interest as the committee shall determine." After due consideration this recommendation was adopted and as a result the first number of the Bulletin has been prepared and issued by Dr. Dana W. Fellows and Messrs. Clarence H. Knowlton and Edward B. Chamberlain, who constitute the present publication committee of the society. The paper is a twenty-four page octavo, prepared with evident care and including, besides detailed reports of the proceedings of the society during its thirteenth meeting, a list compiled by Mr. Chamberlain of the flowering plants and pteridophytes collected or observed by the society during its excursions in the towns of Oxford, Otisfield, and Norway, Maine. Copies of the Bulletin, at ten cents each, can be obtained of Mr. Edward B. Chamberlain, Cumberland Center, Maine.

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Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

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SOME NEW GREEN ALGAE.

F. S. Collins.

(Plate 76.)

The species here noted are only in part from New England localities, but so general is the distribution of plants of this class, that the mere accident of locality of the original station is of little importance; any species of the genera in question is liable to be found in any temperate region.

Pleurococcus marinus n. sp. Cellulis sphaericis, 10–40 μ diam. cum membrana cellulari; membrana 2 μ crassa; colore variante ab auriantiaco intenso ad viridem chlorophyllaceam veram; Reproductione per aplanosporas divisione repitita formatas, 8–64 in cellula; membrana cellulari distincta et admodum crassa dum in cellula matricali; congerie sporarum substantia gelatinosa inclusa, post solutionem cellulae matricalis formam sphaericam diu servante.

Cells spherical, 10–40 μ diam., including cell wall; wall about 2 μ thick; color from deep orange to true chlorophyll green. Reproduction by aplanospores, formed by repeated division, 8–64 in a cell, spore wall distinct and relatively thick while still in the mother cell; mass of spores retaining the spherical form and held in a gelatinous mass long after the disappearance of the mother cell wall.

This plant was distributed through a mass of floating algae in shallow pools in a salt marsh at Stover's Point, Harpswell, Maine, July, 1906. It formed so large a proportion of the mass as to give a brick- or orange-red color to the whole, the other species being *Lyngbya aestuarii* (Mert.) Liebm., *Cladophora expansa* Kütz., and other forms usually found in such localities. It has been distributed as No. 1316 of the Phycotheca Boreali-Americana. The genus *Palmellococcus* was founded by Chodat in 1894,[1] for the single species

[1] Chodat, Materiaux pour servir à l'histoire des Protococcoïdées. Bull. Herb. Boissier, Vol. II, p. 429, 599.

P. miniatus (*Protococcus miniatus* Kütz., *Pleurococcus miniatus* Näg.), which is not uncommon on walls and windows of greenhouses, but whose native habitat is unknown; Chodat reports its reproduction under ordinary circumstances to be by bipartition, rarely quadripartition of the cell; but in culture in pure spring water the contents of a cell is by repeated division sometimes transformed into 16, 32 or 64 spores with delicate membrane, escaping in a mass with a gelatinous envelop. This latter form of reproduction is the only one observed in *P. marinus*, but practically all of the Harpswell material seemed to be in some stage of this process. The color of the cell ranges from deep orange to pure green; the largest cells were green, but cells of this color were found of all sizes down to the smallest. The only distinction other than color was that the largest green cells had a thinner wall than the small or moderate sized cells, either green or orange, and that the colored cells seemed more active in spore formation. The wall of the spore was fully developed while the wall of the mother cell was still perfect; after the disappearance of the latter the spores remained in a spherical gelatinous mass for a long time, until they had increased very materially in size; colonies of 32 cells were observed, retaining the spherical form with a diameter of 100 μ. Some of the plant was kept alive for several weeks, but not under the normal conditions of a salt marsh pool; in this material were finally found numerous spherical colonies, in which the contents of each cell had divided into aplanospores of a second generation, much smaller than any noticed in the normal condition of the plant. From *P. miniatus*, *P. marinus* is distinguished by the larger cells, those of *P. miniatus* being 3–15 μ diam.; by the thicker walls of the aplanospores, and by the totally different habitat. According to the figures of *P. miniatus* in Chodat's Algues Vertes de la Suisse, fig. 80, the gelatinous vesicle of the spores is less regular in form in that species and less persistent.

Chaetomorpha Chelonum n. sp. Filamento erecto, stricto, 12–20 μ diam. ad basin, superne incrassato, usque ad 35 μ in fronde sterili; cellula basali ad 1 mm. longa, cellula proxima ad 10 diam., cellulis superioribus 2–3 diam. longis; membrana cellulari crassa; cellulis fertilibus in parte superiori filamenti ortis, ad 50 μ diam., 1–4 diam. longis, leviter aut admodum moniliformibus aut enim subglobosis; zoosporis per aperturam in media parte cellulae et tubum tenuissimum exeuntibus; ramis pluricellularibus, coralloideis, e cellula basali exeuntibus, stratum basale continuum substrato arctissime adhaerentem formantibus.

Filaments erect, straight, 12–20 μ diam. at base, increasing in size upwards, to 35 μ in the upper part of the vegetative plant; lower cell up to 1 mm. long, next cell up to 10 diam. long, upper cells 2–3 diam.; walls thick; fertile cells in upper part of the filament, up to 50 μ diam., 1–4 diam. long, from slightly moniliform to nearly globular; zoospores escaping by an opening near the middle of the cell, through a very short tube; basal layer a dense mass of very irregular, pluricellular, coralloid branches, forming a dense and continuous expansion on the substratum. On the backs of the turtles, *Chrysemys marginata* and *Aromochelys odorata*, Walnut Lake, Oakland County, Michigan, *Dr. T. L. Hankinson.*

Species of *Chaetomorpha* are abundant in all seas, but very unusual in fresh water, the only species which can be considered as well known being *C. Herbipolenis* Lagerh.,[1] which was found in a hothouse in a botanical garden, the place of its origin being unknown. *C. Henningsii* Richter [2] occurring in fresh water near Berlin, is uncomfortably near the marine *C. aerea*, which is said to be found occasionally in fresh water. The present species seems to be amply distinct from *C. Herbipolensis*, by the smaller diameter, longer basal cell, and especially by the strongly developed basal layer, that of *C. Herbipolensis* being merely an outgrowth from the membrane, while in the present species there are distinctly branching, pluricellular filaments, which unite to form a practically continuous layer on the substratum, the shell of the turtle. The basal developments of the individual plants are so closely united that the appearance is that of a continuous membrane, from which arise numerous erect, bright green, straight filaments, pretty uniformly increasing in size from the base to the apex. The cell wall is thick, in the lower cell about one quarter the diameter; the cells in the vegetative filaments are nearly cylindrical, but the fertile cells are strongly swollen, sometimes nearly globular. The material examined having been preserved in formalin, nothing can be said as to the finer details of the zoospores, but evidently large numbers are formed in a cell. Emptied cells showed plainly an aperture near the middle, the cell wall extending as a very short tube, much like that shown for *C. Herbipolensis*, Pl. IX, fig. 5. Two lots of material were received from Dr. Hankinson, one having grown on *Chrysemys*, the other on *Aromachys*; there was some difference between the two, the former having basal cells longer and more slender than the latter, and fertile cells more distinctly swollen.

[1] G. Lagerheim, Ueber die Süsswasser-Arten der Gattung Chaetomorpha Kütz. Ber. Deutsch. Bot. Ges., Vol. V, p. 185, 1887.

[2] P. Richter, Hedwigia, Vol. p. 70, 1893.

Lagerheim, l. c., p. 201, suggests that fresh water *Chaetomorpha* species should be expected in the United States, especially in Massachusetts, as the algal flora here has an almost tropical character. This characterization, which hardly seems to harmonize with the weather of the past winter and spring, was based on his inspection of desmids from Tewksbury. The occurrence of a fresh water *Chaetomorpha*, even farther north than Tewksbury, is of interest.

Cladophora (**Aegagropila**) **amphibia** n. sp. Filamentis inferioribus contortis; cellulis forma et magnitudine inaequalibus, subcylindricis, 2–5 diam. longis, 40–70 μ diam., aut 1–2 diam. longis, ad 100 μ diam. in parte media incrassatis; filamentis abunde et irregulariter ramosis, ramis similibus, filamentis ramos erectos etiam gerentibus, 30–50 μ diam., cellulis 4–8 diam. longis, subcylindricis at plus minusve irregularibus, paucos ramulos breves patentes emittentibus; cellula terminali obtusa vel truncata; rhizoidis incoloribus interdum a cellulis inferioribus ortis.

Lower filaments contorted, cells of irregular form and size, subcylindrical, 2–5 diam. long, 40–70 μ diam., or 1–2 diam. long, swollen to 100 μ diam. in the middle, freely and irregularly branched, branches of similar character; also bearing erect branches, 30–50 μ diam., cells 4–8 diam. long, subcylindrical but somewhat irregular, bearing a few mostly short and patent branches; terminal cells obtuse or truncate; slender colorless rhizoids occasionally produced from the lower cells. On damp ground, among *Salicornia*, in a salt marsh, Alameda, California, Sept. 26, 1903, *W. J. V. Osterhout & N. L. Gardner*. Distributed as P. B.–A., No. 1284.

This plant forms a thin extended layer on ground covered only at the highest tides, and has the habit of a *Vaucheria*. The lower part is densely matted, the upper surface is formed by the free ends of the erect branches. These erect branches are fairly regular in form, varying from a true cylindrical shape about as do the filaments of a *Rhizoclonium*; the basal filaments, however, are very irregular, the cells varying from long and cylindrical to short and ovoid, or of a triangular section, the latter apparently where a branch is starting from a short cell; cells of larger and smaller diameters may alternate, or there may be a series of swollen cells, giving a moniliform appearance. Some of the filaments end in a large, ovoid cell, others taper to a slender, tortuous rhizoid. In many cases the first cross wall in a branch is quite a distance from the base, reminding one of *Siphonocladus*. The cell wall is quite thick; the color is a dull green. Although observed by Dr. Gardner for a long time, no indication of spores was seen.

Vaucheria longipes n. sp. Filamentis 80–90 μ diam., sparse et irregulariter ramosis; ramo sporifero, 30–40 μ diam., sub angulo recto exeunte, 1–6 mm. longo, antheridium terminale, cylindricum aut paulo attenuatum, hamatum vel circinatum sustinente; oogoniis 2–4, ovoideis, subobliquis, pedicellatis, 70–85 × 35–40 μ, antheridium superantibus; rostro 15 μ longo; pedicellis 100–150 μ longis, 20–30 μ diam., sub antheridio ortis.

Filaments 80–90 μ diam., oogonia and antheridia borne at the end of a branch 1–6 mm. long, 30–40 μ diam.; antheridium terminal, cylindrical or slightly tapering, hooked or circinate; oogonia 2–4, ovoid, somewhat oblique, pedicelled, 70–85 × 35–40 μ, usually surpassing the antheridium; pedicels 100–150 μ long, 20–30 μ diam., arising just below the antheridium; beak 15 μ long. In a ditch by the roadside, Ross Valley, California, Jan., 1904. *N. L. Gardner.*

Somewhat resembling *V. geminata*, but distinct by the very long fruiting branches, at right angles to the filaments, as well as by the more elongate oogonia, borne on longer pedicels.

V. Gardneri n. sp. Filamentis 50–70 μ diam., sparse ramosis, ramis sub angulo recto exeuntibus, non attenuatis; chromatophoris parvis; antheridiis plerumque solitariis, raro 2–4, et oogoniis 2–4, raro pluribus, pedicellatis, pedicellis basi connatis, 60–100 μ longis, 15–20 μ diam.; antheridii pedicello angulo recto vel subrecto posito; pedicellis oogoniorum circumcirca positis, sub angulo 45° exeuntibus; antheridio hamato vel circinato, ad 10 μ diam. attenuato; oogoniis plerumque sat obliquis, saepe introrsum concavis, 85–95 × 70–75 μ; plerumque antheridium superantibus; rostro circa 15 μ longo.

Filaments 50–70 μ diam., sparingly branched, branches issuing at a right angle, not tapering; chromatophores small; antheridia generally single, rarely 2–4; oogonia 2–4, rarely more; both pedicelled, pedicels connate at the base, 60–100 μ long, 15–20 μ diam.; pedicel of the antheridium at a right angle or nearly so; pedicels of the oogonia arranged around it at an angle of about 45°; antheridium hooked or circinate, tapering to 10 μ diam.; oogonia usually quite oblique, often concave on the inside, 85–95 × 70–75 μ; generally surpassing the antheridium; beak about 15 μ long. In a small pool, Mountain View Cemetery, Oakland, California, May 6, 1903; in a ditch by the roadside, Berkeley, California, April 15, 1905. *N. L. Gardner.* Distributed as P. B.-A., No. 1288.

Forma **tenuis** n. forma. Filamentis 30–40 μ diam.; oogoniis et antheridiis ut apud formam typicam, sed numeris variantibus; antheridiis haud infrequenter 2, oogoniis 1–5.

Filaments 30–40 μ diam., oogonia and antheridia as in the type, but in varying numbers; antheridia not infrequently 2, oogonia 1–5. In company with *V. longipes.*

This species is not unlike *V. longipes*, but the pedicels bearing the

organs of fructification are placed directly on the filament, radiating from one spot; the oogonia are much more oblique, often concave inside. When there are two oogonia and one antheridium, there is a certain resemblance to *V. geminata*; but the slender radiate pedicels make it amply distinct; the forms with many oogonia and antheridia are quite unlike anything else. The largest number of pedicels observed in one group is twelve; four bearing antheridia, eight oogonia.

Malden, Massachusetts.

Explanation of Plate 76.

Fig. 1, Vaucheria longipes.
Fig. 2, V. Gardneri, group of four oogonia and one antheridium.
Fig. 3, " " group of two " " " "

THREE PLANTS FROM MAINE.

Ora W. Knight.

During the fall of 1906 while collecting along the shore near Otter Cliffs, Mount Desert Island, I found a very peculiar form of *Juniperus horizontalis* Moench, with lobed fruit, growing in an extensive patch by itself, while elsewhere the typical plant prevailed. As this plant seems worthy of a name I propose to call it:—

Juniperus horizontalis Moench, forma **lobata**, forma nov.

Characters:— differs from *J. horizontalis* in having more elongate fruit which is strongly two-, three- or even four-lobed at the apex. The fruit when mature is pale green in color, slightly tinged with bluish, or occasionally pale greenish blue. Type locality: rocky cliffs along shore, Otter Cliffs, Mount Desert Island, Maine. Type No. 5311 O. W. K., October 3, 1906.

For two seasons I have had under observation a very peculiar hybrid *Pyrus* whose exact affinities were open to some slight doubt at first, but as the question now seems satisfactorily settled I propose to call it:—

Pyrus Americana × **arbutifolia,** comb. nov.[1]

[1] [Hybrids ascribed to the same parentage have been observed in cultivation. See, for example, Schneider, Ill. Handb. d. Laubholzk. i. 677.— Ed.]

Shrub about 1 meter tall; foliage very variable, glabrous above, pubescent beneath even when mature; the leaves either simple, oblong-ovate and dentate or entire, or variously lobed, or compound and composed of five to seven oblong-ovate leaflets with margins dentate or entire; peduncles and pedicels pubescent; cymes decompound, fifteen- to thirty-flowered, the flowers not appreciably different from those of *Pyrus Americana* (Marsh.) DC.; fruiting pedicels and young twigs pubescent; mature twigs glabrous, similar in color to those of *Pyrus Americana*; fruit only sparingly maturing, a majority of the blossoms not being fertilized, red, 6 mm. in diameter, not distinguishable externally from that of *Pyrus Americana*; the seeds very abortive, showing no embryos in the case of several examined. Fruit ripe and falling August 12, 1906. Type locality: growing associated with supposed parents, Bicycle Path, Bangor; flowering specimens June 9, 1905; fruit August 12, 1906. Type specimen No. 5224 O. W. K.

Along the shores of the Penobscot at Bangor, growing near the type of *Salix coactilis* Fernald, is a shrub, which at certain stages of growth I have been inclined to refer to *S. coactilis* although later in the season it more nearly resembles *S. cordata* Muhl. After study of this peculiar shrub for several seasons its true affinities seem well established and I propose to call it:—

Salix coactilis × cordata, hyb. nov.

Characters:— Shrub about 2 meters tall; branchlets reddish green to blackish and somewhat quadrangular; youngest branchlets gray and pubescent to puberulent; leaves oblong to lance-ovate, long-acuminate, petioled, at first reddish green to red beneath and pubescent, especially on mid-rib and veins, above deeper red, pubescent on the mid-rib at least, becoming green with age but always paler below and remaining pubescent on mid-ribs above and below, in maturity 6 to 12 cm. long, 2 to 4 cm. broad, rather finely and somewhat irregularly glandular-dentate; petioles pubescent even in maturity; stipules semi-ovate, glandular-toothed, persistent on the younger branchlets, 4 to 10 mm. long; aments on short leafy peduncles, expanding with the leaves, in anthesis 1 to 2.5 cm. long, in fruit 2 to 4 cm. long, 7 mm. thick; scales oblong or obovate, blunt at tip, blackish, very pubescent with silky hairs longer than blade; capsule glabrous, conic-subulate, pedicelled, about 3 mm. long, the pedicel about 1 mm. long; style about 1 mm. long; stigma short, two-lobed; capsules generally abor-

tive, but occasionally producing one or two fertile seed. Type locality: bank of Penobscot River, Bangor, May 16 and June 7, 1904. (No. 35 O. W. K. Type). In general appearance the plant is almost exactly intermediate between *S. cordata* and *S. coactilis*, the aments having a marked resemblance to those of *S. cordata*, while in other characters the shrub resembles *S. coactilis*.

Bangor, Maine.

SALICORNIA EUROPAEA AND ITS REPRESENTATIVES IN EASTERN AMERICA.

M. L. Fernald.

The annual Saltwort or Samphire of our salt marshes, which has passed very generally under the name *Salicornia herbacea*, presents, upon the coast of New England and eastern Canada, three strongly marked tendencies to which it is here proposed to call attention. But first we must consider briefly the nomenclatorial status of the species, which has been recently called to mind by Messrs. Britten and Rendle of the British Museum.[1]

Linnaeus, in the first edition of the Species Plantarum (1753), enumerated four species of *Salicornia*, with the first of which alone we are here concerned. This was

"1. SALICORNIA articulis apice crassioribus obtusis. *europaea*. *Mat. med.* 8. herbacea.
Salicornia herbacea. *Fl. suec.* 1.
Salicornia annua. *Sauv. monsp.* 7.
Salicornia. *Hort. cliff.* 490. *Roy. lugdb.* 205.
β Salicornia semipervivens. *Sauv. monsp.* 7. fruticosa.
Kali geniculatum majus. *Bauh. pin.* 289.
Habitat in Europæ litoribus maritimis. ♄ ⊙
Conferantur annua & sempervirens *utrum specie distincta?*"[2]

In the 2d edition (1763) of the Species, Linnaeus entirely discarded the name *Salicornia europaea* and published the name *S. herbacea* for

[1] Britten & Rendle, Journn. Bot. XLV. 104 (1907).
[2] L. Sp. 3 (1753).

the annual plant, setting off as a distinct species the perennial *S. fruticosa.* Subsequent authors have been inclined to follow the second edition of the Species instead of the first, and to designate the annual plant of both Europe and America as *S. herbacea* L. (1763).

The name *Salicornia europaea,* however, as shown not only by its position on the page but by its italic-type, was intended by Linnaeus, in 1753, to designate a species embracing two variations, one annual and herbaceous, the other evergreen and fruticose; and it must, of course, be retained for at least one of its components, although in 1763 Linnaeus himself discarded the name. In fact, in 1762, one year prior to the publication of the name *Salicornia herbacea,* the annual herbaceous plant was clearly treated by Hudson, in his Flora Anglica, as *S. europaea,* and several forms (including the fruticose plant) were indicated without names. Thus it is doubly certain that the herbaceous plant, clearly defined by Hudson in 1762 as *S. europaea,* should retain that name instead of the later *S. herbacea* of Linnaeus (1763).

The plant which is usually interpreted as typical *Salicornia europaea* (*S. herbacea*) is somewhat bushy-branched, with the ascending simple or commonly forking spikes comparatively slender (1.5–2.5 mm. thick). This plant is common on our Atlantic coast, from eastern New Brunswick to Georgia, and it occurs in alkaline places in the interior of New Brunswick and New York, also on the Pacific coast.

Another plant, differing somewhat from the typical *Salicornia europaea* in having the elongate spikes much thicker (3–4.5 mm. thick) and more commonly simple or subsimple, is represented in the herbaria examined by several sheets from the coast of New Brunswick, Nova Scotia, and New England, and from Salina, New York; and it is apparently of wide distribution. This thick-spiked extreme seems to be the plant described by Koch as *S. herbacea, β pachystachya.*

The third plant is more distinct from the upright bushy-branched *Salicornia europaea,* for its freely-forking branches are very lax and often drooping, the lowermost commonly much elongated and quite prostrate upon the ground. The plant, thus forming closely prostrate or loosely spreading mats, is the characteristic representative of the species about the mouth of the River St. Lawrence, and from there it follows the coastal marshes southward as far as the entrance to the Bay of Fundy. It also occurs in alkaline places in the Saskatchewan region. This plant is identical with much Old World material which is considered without question to be *S. prostrata* Pallas. In its best

development it appears sufficiently distinct from *S. europaea*, but the distinctions seem to be merely habital, and no characters of flower or fruit have been found by which it can be separated from the upright plant.

A fourth plant, known from the Valley of the Red River of the North in Minnesota and Manitoba to central Kansas and the Rocky Mountains, should be watched for in alkaline regions farther east. This is the recently described *Salicornia rubra* Nelson, which resembles typical *S. europaea*, but is easily separated by the shorter joints of the spikes.

The distinctions and nomenclature of these four annual plants with blunt or bluntish inconspicuous scales may be summarized as follows.

* Joints much longer than thick, conspicuously exceeding the middle flower.

S. europaea L. Erect (1–4.5 dm. high), from simple to freely branched, the *branches ascending*, green, turning red in autumn; scales obscure and very blunt, making a truncate barely emarginate termination of the long joints of the *slender* (1.5–2.5 *mm. thick*) tapering *spikes*; *middle flower* much higher than the lateral ones, *shorter than the joint*; fruit pubescent; seed 1.3–2 mm. long.— Sp. 3 (1753); Huds. Fl. Angl. 1 (1762); Britten & Rendle, Journ. Bot. XLV. 104 (1907). *S. europaea* (*herbacea*) L. Sp. 3 (1753). *S. herbacea* L. Sp. ed. 2, 5 (1763); and most later authors.— Salt marshes of the coast, New Brunswick to Georgia; interior salt springs, etc., New Brunswick and New York; also on the Pacific coast. (Eurasia.)

Var. **pachystachya** (Koch) n. comb. *Spikes much thicker* (3–4.5 *mm. thick*).— *S. herbacea, β pachystachya* Koch, Syn. ed. 2, 693 (1844). — Similar range, less common.

Var. **prostrata** (Pallas) n. comb. *Branches horizontally spreading or drooping*, very soft and lax, the *lowest much elongated and decumbent*; or the whole plant depressed and matted.— *S. prostrata* Pallas, Ill. Pl. 8, t. 3 (1803). *S. herbacea, β prostrata* Moq., Chenop. Enum. 115 (1840).— Brackish or alkaline shores, Lower St. Lawrence River to Washington County, Maine.

* * Joints about as thick as long, scarcely exceeding the middle flower.

S. rubra Nelson. Bushy-branched (0.5–2 dm. high), the abundant simple or forking branches ascending, turning red in autumn; scales broadly triangular, blunt or subacute; spikes slender-cylindric (2–3.5 mm. thick), blunt, rather closely jointed; flowers crowded, the middle

one higher than the others and usually reaching the tips of the joints; fruit pubescent; seed 1 mm. long.— Bull. Torr. Bot. Cl. xxvi. 122 (1899).— Low alkaline places, Manitoba and western Minnesota to central Kansas, and westward to the Rocky Mts.

GRAY HERBARIUM.

NOTES ON PLANTS OF CHESTERVILLE, MAINE.

LILLIAN O. EATON.

IN addition to the interesting plants of Chesterville already reported[1], the following, perhaps worthy of note, have been found in this vicinity, during the past few seasons. The grasses and sedges were collected and determined by Mrs. Agnes Chase of the Department of Agriculture at Washington, in the summer of 1906; the remaining plants, unless otherwise stated, being the collections of the writer. For aid in final identification of various species I am indebted to Dr. D. W. Fellows, Mr. A. A. Eaton, and Professor M. L. Fernald.

Oxalis Acetosella L., var. *subpurpurascens* DC. A few plants of this variety were found in a cedar swamp, among a thick colony of the species, by Mrs. Chase and the writer, July 3, 1906. The variety differed from the typical *O. Acetosella* only in a whitish appearance of the foliage and in the color of the petals, the latter being wholly a purplish-pink. After identifying the plants, Mr. Fernald writes: "I have known this variety in America only from Manchester, Vermont."

Lysimachia thyrsiflora L. Fence-row, in damp soil, July, 1906 (*F. J. Keyes*).

Sabbatia campestris Nutt. A single well flowered plant was found, September, 1906, on ground left fallow for a season.

Spiranthes Romanzoffiana Cham. Roadside ditch, August, 1906. Also found in a field, August 14, 1902, by C. H. Knowlton (See Ames, Orchidaceae, fasc. i. 139).

Scheuchzeria palustris L. Abundant on one bog, August, 1904.

Carex pauciflora Lightf. Plentiful on two bogs, July and August, 1904.

[1] RHODORA, ii. 123; v. 82.

Carex Backii Boott (*C. durifolia* Bailey).

Glyceria nervata Trin., var. *stricta* Scribn.

Panicum Werneri Scribn.

" *tennesseense* Ashe.

Phegopteris hexagonoptera Fée. A large colony on a shaded hillside, July, 1905.

Aspidium spinulosum Swartz (typical). On a rocky hill in partial shade, the plants evidently increasing.

South Chesterville, Maine.

The Dwarf Mistletoe on the Southeastern Coast of Maine. — The recent articles calling attention to *Arceuthobium pusillum* at different points in Maine prompt this note, supplementing the series of Maine records.

The plant first came to my attention during July, 1902, at West Jonesport, occurring rarely on Black Spruce, on the main land. Late in July, 1904, at Cross Island, off the mouth of Machias Bay, the plant was found in great profusion, again on Black Spruce. Here it infested patches of limited extent, with larger patches free from infection.

On Matinicus Island, off the coast of Maine, on August 4th, 1907, this plant was found in greater abundance and size than I have seen it previously. It infested the small, exceedingly dense or "scrubby" White Spruces about the Northwest Head.

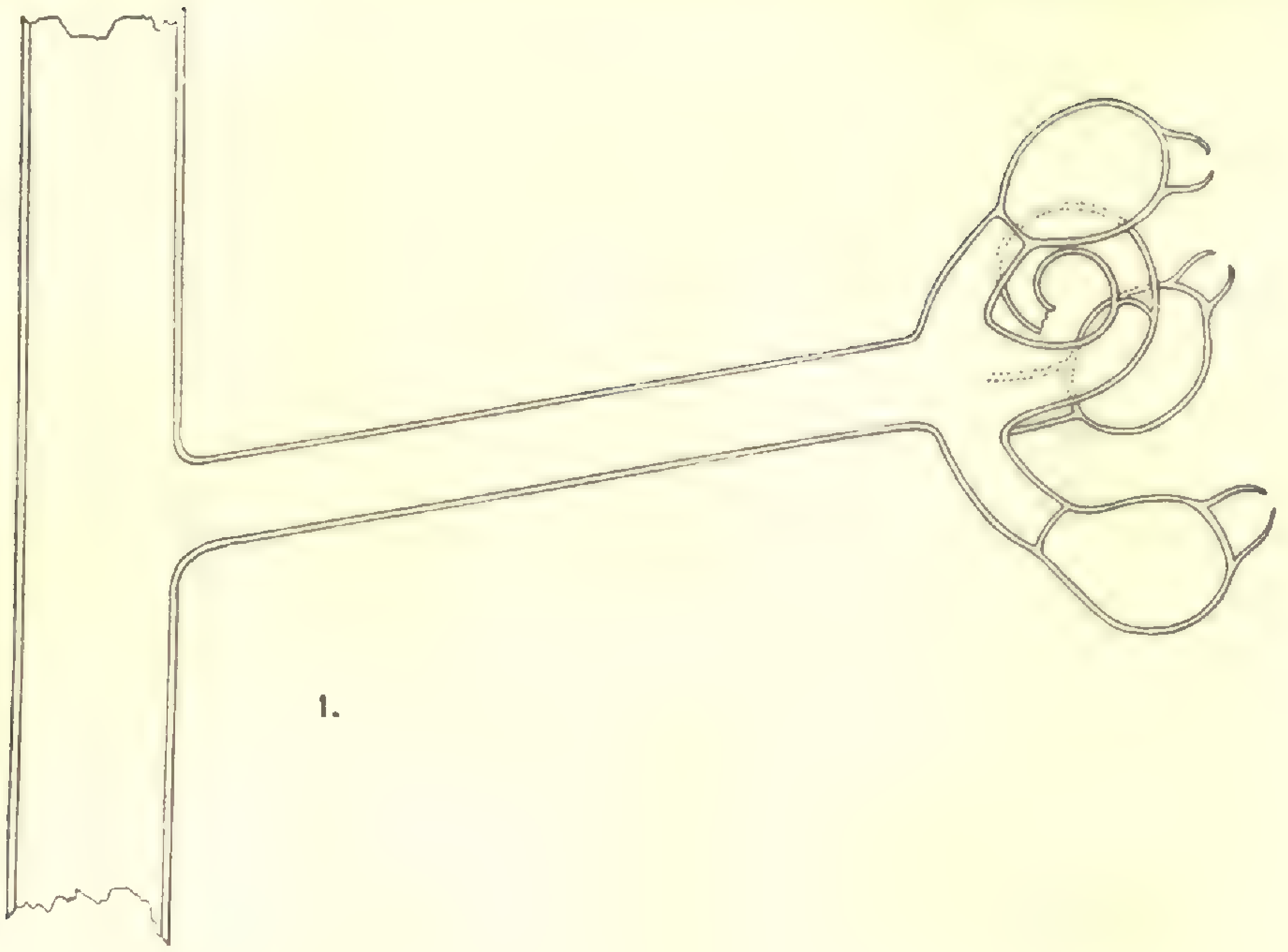
I have often looked, vainly, for it about Casco Bay, yet we are now warranted in considering that it has been shown to occur throughout the northern, central, and eastern portions of the State.[1] The regularity of its distribution is another question, deserving of many reports. — Arthur H. Norton, Portland, Me.

[1] The following records are to be found in Rhodora.

Vol. ii.	2 (1900):	*von Schrenk* — Monhegan Island, Boothbay, Linekin.
	10 (1900):	*Fernald* — Fort Kent, Upsala.
	221 (1900):	*Arthur* — Isle au Haut.
Vol. v.	49 (1903):	*Harvey* — Mt. Katahdin.
Vol. viii.	168 (1906):	*Chamberlain* — Pleasant Ridge.
Vol. xi.	28 (1907):	*Murdoch* — Rangeley.
	75 (1907):	*Rand* — Mt. Desert Island.
	124 (1907):	*Chamberlain* — Norway — Casco.

[*Arceuthobium* is also found in Alton and Georgetown — Eds.]

Vol. 9, No. 105, including pages 149-196 was issued 13 September, 1907.



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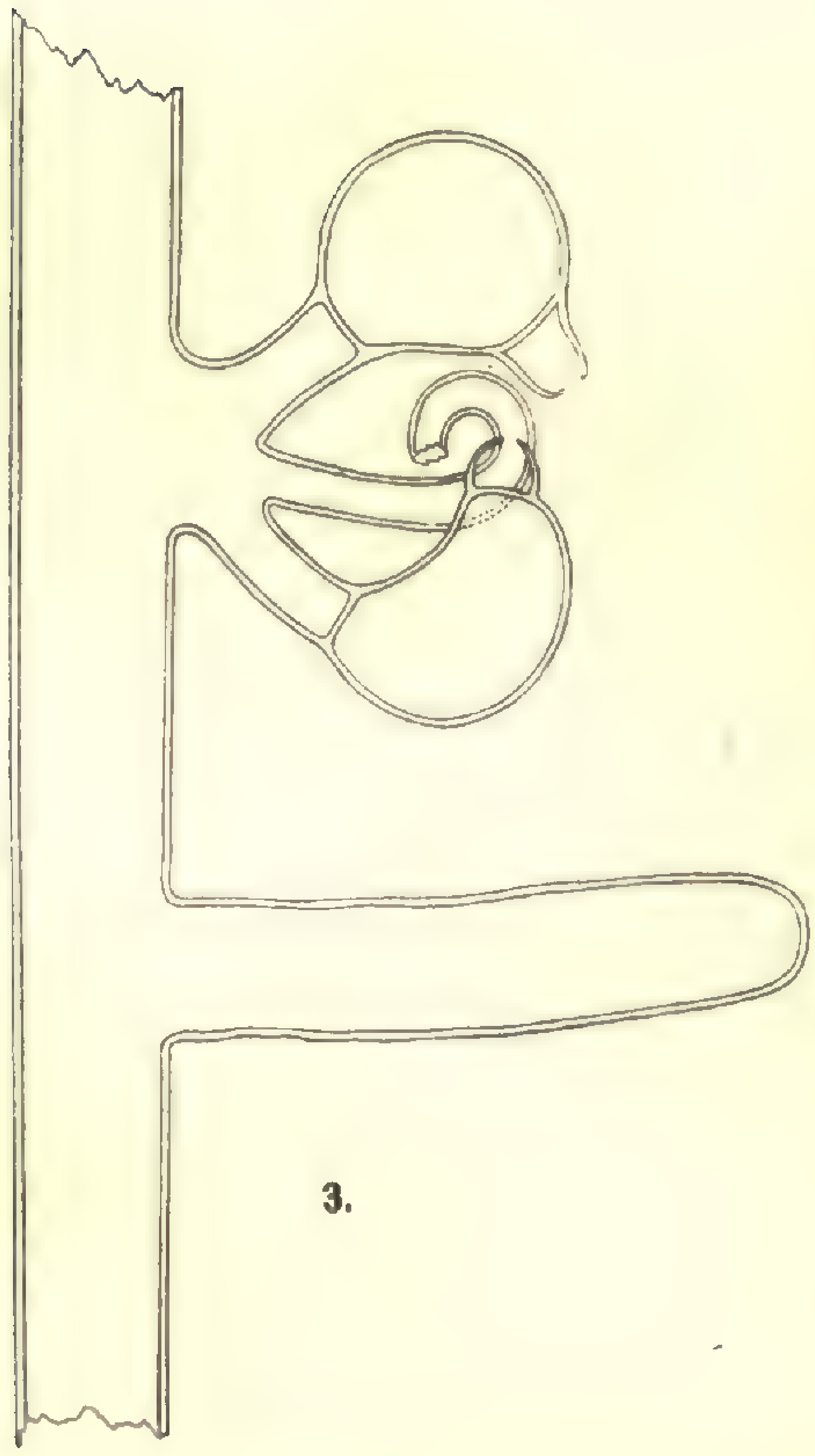

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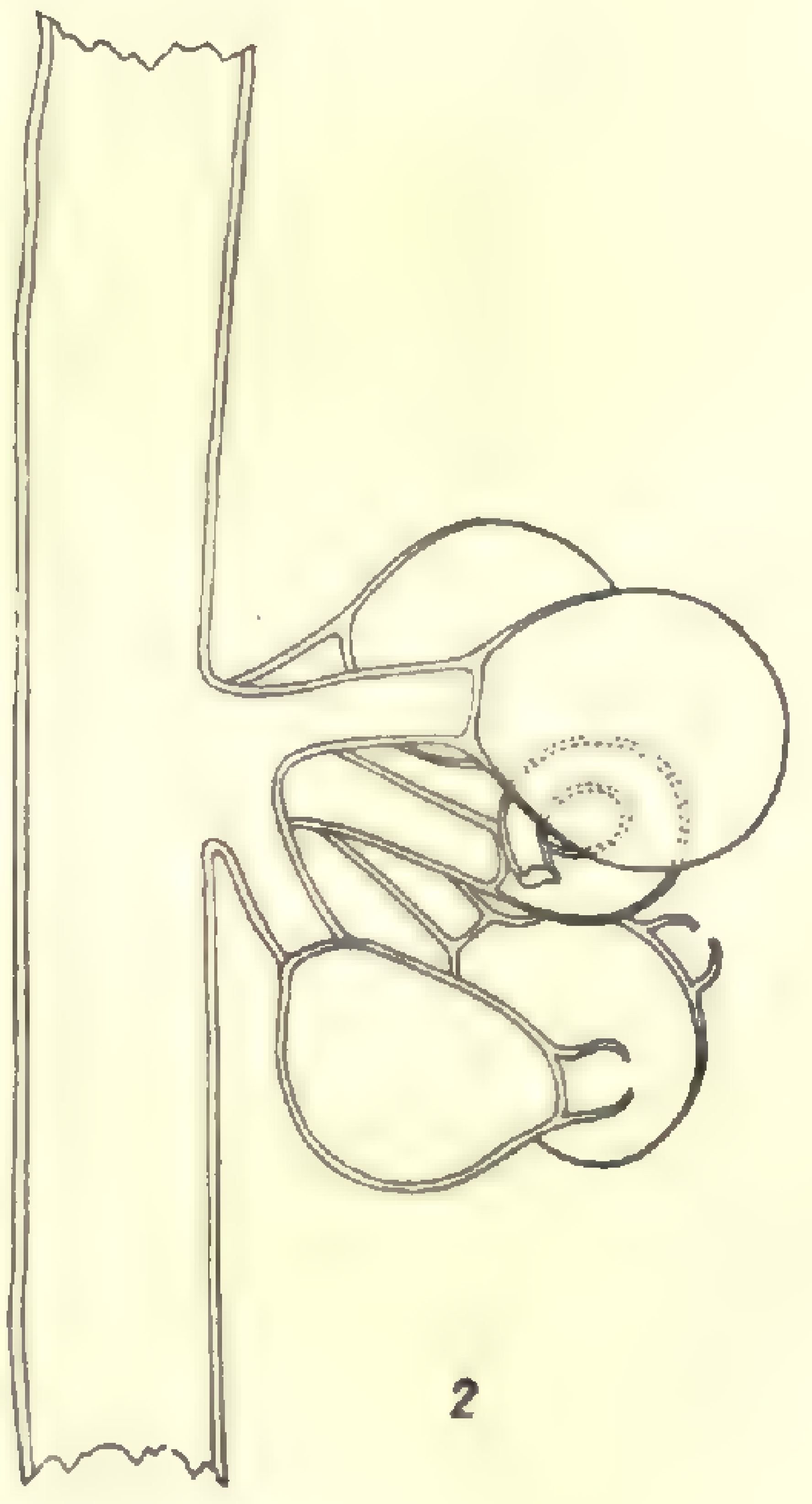

2

N. L. Gardner ad nat. del.
Redrawn for reproduction by
F. Schuyler Mathews.

Fig. 1. VAUCHERIA LONGIPES. Figs. 2–3. V. GARDNERI.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 9. **November, 1907.** **No. 107.**

AN ALPINE VARIETY OF HOUSTONIA CAERULEA.

Arthur Stanley Pease and Albert Hanford Moore.

The striking white flowers of *Houstonia caerulea* in Tuckerman's Ravine have long attracted the attention of the numerous persons who travel through it every year, whether botanists or not, since these flowers form a very conspicuous part of the flora of the ravine.[1] The beautiful white color of the corolla, and brilliant yellow of the throat and upper part of the tube have for a long time led the authors to wonder if the plant in question might not be distinct from the lowland species. Several collections and a careful study at the Gray Herbarium have confirmed this suspicion.

The variety of Tuckerman's Ravine and the Alpine Garden may be readily distinguished by the color characters above referred to, together with the shape of the corolla tube. In the case of the alpine variety, the tube tapers gradually downward from the limb to the base without any striking differentiation into a broader and narrower portion. In the common variety, on the other hand, there is a long, straight, much more exserted tube, and then an abrupt, but usually narrow, funnel-like broadening just beneath the border. The following measurements, while not practicable for purposes of identification, are interesting evidences of the distinctness of the two phases. A careful series of measurements of the breadth of the corolla-tube at the widest portion, immediately below the limb, and the total length of the tube shows that, while individual measurements in both plants overlap, the averages are quite different. The average width in the mountain variety was found to be 2.04 mm. and the average length 3.41 mm. In the lowland plant these figures were respectively 1.80 and 4.58 mm.

[1] Cf. G. S. Miller in Proc. Bost. Soc. Nat. Hist. xxvi, 178 (Feb. 7, 1894) foot-note, "A very large, pale form, apparently distinct from the lowland plant."

The average ratio in the first instance was .59 and in the second .39. The measurements of the width range from 1.25–3 mm., those of the length from 3–4 mm. for the new variety, but from 1–2.75 mm. and 3–6 mm. respectively for the common variety.

Houstonia caerulea is described by Linnaeus as being blue. The ordinary lowland plant is not infrequently white, and has always a yellow throat, but this feature is not so striking, and it has the customary corolla-tube of the Bluet. It is presumably this phase which is referred to by Millspaugh in Flora of West Virginia, 375 (1892) as *Houstonia caerulea f. albiflora*, but it is listed without description.

The authors take great pleasure in dedicating the variety, whose characterization follows, to the late Edwin Faxon and to Charles Edward Faxon, now connected with the Arnold Arboretum, two brothers, whose collections of the flora of Mount Washington and vicinity have been among the most extensive and valuable in recent years.

Houstonia caerulea L. var. **Faxonorum** Pease et Moore var. nov. Flores candidi, faucibus flavissimis; corollae tubus sensim a limbo usque ad basim constrictus; tubi maxima latitudo 1.25–3 mm. (plerumque 2.04), longitudo 3–4 mm. (plerumque 3.41). Distributio in alpinis Montium Alborum.

Houstonia serpyllifolia Grah. (not Michx.) in Bot. Mag. lv, pl. 2822 (1828). Here the above variety is clearly figured. For an illustration of the type see Bot. Mag. xi, pl. 370 (1797).

Type specimen: New Hampshire, Coös County, Headwall of Tuckerman's Ravine, Sargent's Purchase, July 29, 1907 (*A. H. Moore*, no. 4047 in Herb. Moore. Co-types in Herbb. Gray, Pease, and Bartlett).

Other specimens examined: New Hampshire, Coös County, Headwall of Tuckerman's Ravine, Sargent's Purchase, August 14, 1902 (*A. H. Moore*, no. 291) and August 28, 1907 (*A. S. Pease*, no. 10732); Alpine Garden, Sargent's Purchase, August 19, 1907 (*A. S. Pease*, no. 10558); Mt. Washington, within 2–300 ft. of summit, Sargent's Purchase, August 6, 1897 (*W. Deane*).

Cambridge, Massachusetts.

MENDEL'S LAW OF DOMINANCE IN THE HYBRIDS OF VIOLA.

E. Brainerd.

In a recent paper [1] I gave some account of certain experimental cultures of the offspring of violet hybrids. It was shown that these seedlings diverge in a striking manner from the mother plant and from each other, in accordance with the laws of heredity that Mendel found to control the progeny of a hybrid. During the past summer I have been able to trace the operation of these laws in the characters of the petaliferous flowers of these seedlings, and in several cases have raised a second generation of seedlings.

In these experiments it has clearly come to light, that in some particulars at least, Mendel's Law of Dominance finds illustration among violet hybrids. The special instance of this that I wish to present in detail, relates to the inheritance of color of capsules and of seeds in *V. hirsutula* × *papilionacea*, briefly discussed in Rhodora, ix. 93, June 1907.

The putative parents of this hybrid differ from each other as shown in the following table:—

		V. hirsutula	V. papilionacea
Leaves	habit	nearly prostrate	erect
	width	2–4 cm.	5–10 cm.
	upper surface	hirsutulous	glabrous
	petioles	glabrous	somewhat hairy
Flowers	color	reddish purple	deep violet
	spurred petal	villous	glabrous
Capsules	length	6–8 mm.	10–15 mm.
	color	purple	green
	number of seeds	20–30	50–70
Seeds	length	1.6 mm.	2 mm.
	color	buff	dark brown

The offspring of the hybrid present, in the most varied manner, a redistribution of most of these points of difference. Segregation in leaf characters was especially well marked. The differences in size of capsule and in number of seeds were obscured by the impairment

[1] Read before sections F & G of the A, A. A. S., Dec. 27, 1906, and printed in Science June 14, 1907.

of fertility, which though not as great as in many violet hybrids, was yet in some plants sufficient to make the evidence ambiguous. Attention will be here restricted to the two points of color difference, in which Mendelian dominance is plainly manifest.

In the hybrid from the wild the capsules are a reddish purple, like those of *V. hirsutula.* The tendency to produce the green capsules of the other parent is however present, for it appears in some of the offspring; but in the mother hybrid it is overpowered by the conflicting tendency to produce purple capsules. In Mendel's language, the purple color is 'dominant,' the green color 'recessive.' In like manner it appears that the brown seed-color of *V. papilionacea* is dominant over the buff seed-color of *V. hirsutula.* Mendel represented dominant characters by capital letters, recessive characters by the corresponding small letters. Following his practice, we may let **A** stand for the purple capsule-color, and **a** for the green capsule-color; **B** for the brown seed-color, and **b** for the buff seed-color. One parent, *V. hirsutula,* will then be marked as **A.b;** the other, *V. papilionacea,* as **a.B;** and the hybrid resulting from their sexual union as **Aa.Bb**.

The plants from the wild are presumed to have been the immediate result of the crossing of the two species, — what are technically known as F_1's. It may well be that they are removed one or more generations from the original cross; but this is not of especial importance in the present experiment, as it will be seen that these particular plants, so far at least as respects the two color qualities under investigation, are hybrids of exactly the same status as 'first crosses.'

From the close-fertilized seeds of these plants I raised in 1906 11 offspring, F_2's; and in 1907, 10 offspring; in all, 21. Among these all the four Mendelian forms were found to occur, in number and character as follows:

10	plants	had	purple	capsules	and	brown	seeds,	apparently	**A.B.**
3	"	"	"	"	"	buff	"	"	**A.b.**
5	"	"	green	"	"	brown	"	"	**a.B.**
3	"	"	"	"	"	buff	"		**a.b.**

A close approximation to the theoretically required ratio of '9:3:3:1' is to be expected only when there are several hundred individuals; but even in the small number here shown there is a decided plurality of **A.B's**.

The different forms of these capsules and their seeds are shown in

fig. 1, in which the purple capsules and brown seeds are shaded, and the green capsules and buff seeds are left white.

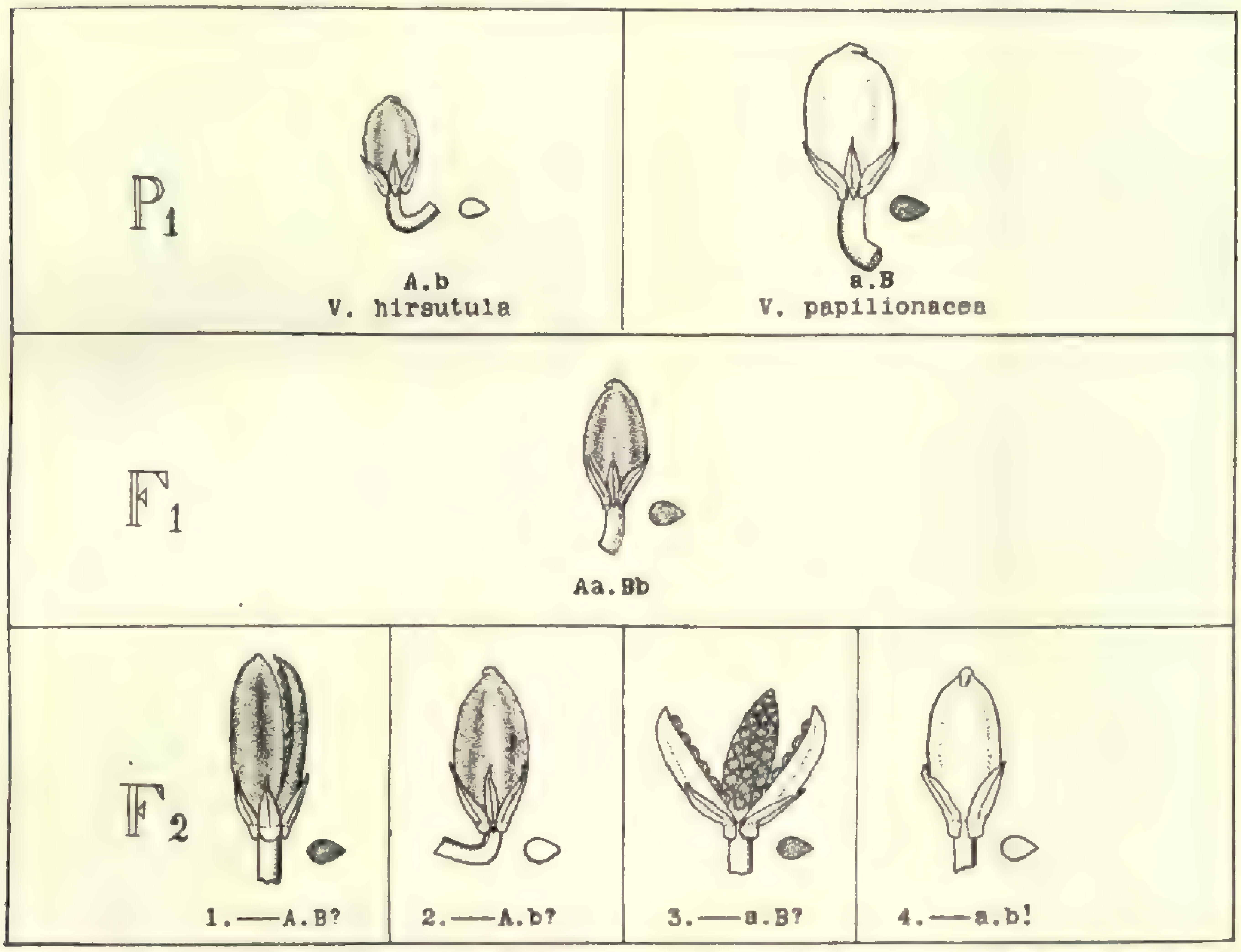

Fig. 1.—Capsules and Seeds of Viola hirsutula × papilionacea, and of its Parents and Offspring.

In 1907 offspring were obtained of six different plants of the eleven raised in 1906. In order to interpret the results, the reader who is not familiar with the laws of Mendel, will be helped by a brief preliminary discussion of the real nature of the four forms of F_2 that appear as the product of the first sowing. As a matter of fact there are five other forms, that masquerade under one or another of the first three forms shown above. We are not sure, among these, in a plant with purple capsules, but that there is also a latent tendency to produce green capsules, kept in check in this individual plant by the dominance of the purple tendency, but able to assert itself in some of the offspring That is, we do not know whether the **A** is pure **A** or **Aa**. Similarly we are not sure in a plant that bears brown seeds but that there is also a latent tendency to bear buff seeds, repressed in this individual plant by the stronger tendency to bear brown seeds, but able to

assert itself in some of the offspring; **B** may be simply **B** or **Bb**; it may be pure or hybrid. Accordingly, under form 3 above we may have either **a.B.** or **a.Bb**; under form 2 either **A.b** or **Aa.b**; and under form 1 either **A.B**, **A.Bb**, **Aa.B**, or **Aa.Bb**. The fourth form, **a.b**, is without ambiguity. These possibilities are pictured in the following diagram, in which the latent hybridity is represented by small crosses on capsule or seed.

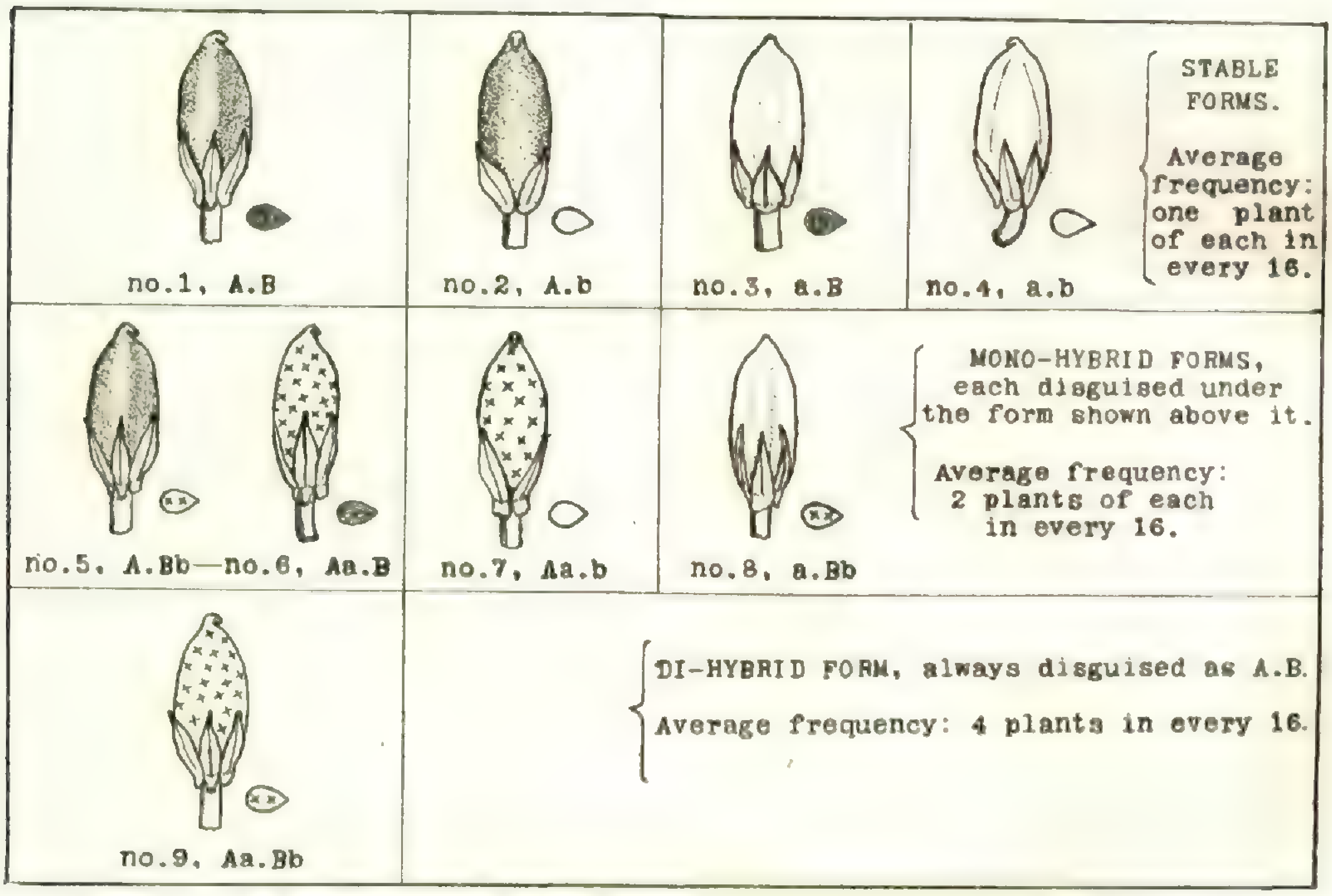

Fig. 2.—Color Forms in Offspring of V. hirsutula × papilionacea.

It will be seen at once that to determine the real nature of any one of the first three of the F_2's in fig. 1, we need to grow its seeds. The apparent forms of the six plants whose seeds were sown, and of their offspring, are given in the following table:

Form of F_2	A.B	A.B	A.B	A.b	a.B	a.b
Seed-number	340	337	339	334	333	338
Forms of F_3 obtained, and the number of plants of each form.	A.B–4	A.B–4				
		A. b–1		A.b–4		
	a.B–2	a.B–3			a.B–6	
			a.b–1			a.b–5

The plants raised from these six sowings were so few (largely from lack of time to transplant) that the numerical results are unimportant;

but in no instance is there a failure to comply with the laws of Mendel. The following points should be noted:—

1. In the sowing numbered 338 all five offspring are like the parent **a.b**,— have green capsules and buff seeds; a recessive character (in this case a double recessive) must always breed true. Here we have a new and stable form, which as a whole is unlike either of the original species.

2. We may infer that the plant from which seeds numbered 333 were obtained was probably pure, that is, was really **a.B** and not **a.Bb**; had it been the latter, one or more of the six offspring would probably have had buff seeds, or been **a.b**. Perhaps as regards capsule-color 334 was also pure,— **A.b** and not **Aa.b**. If so, we should have here in color characters complete reversions to the respective grandparents, *V. papilionacea* and *V. hirsutula.*

3. In sowing 339, though only one seed germinated, it tells the whole story regarding the form of the parent,— it must have been the di-hybrid **Aa.Bb**, and thus exactly like the immediate parent F_1. A plant with purple capsules and brown seeds produces one with green capsules and buff seeds; a feat to be expected of a di-hybrid, though only once in every sixteen plants that it reproduces.

4. The proof is equally clear that in sowing 337 we have the seeds of another di-hybrid; it throws both sorts of capsules and both sorts of seeds.

5. In sowing 340 the result is somewhat ambiguous;— the mother may be either **Aa.Bb** or **Aa.B**; it could not be **A.Bb** or **A.B**.

6. Though three apparent **A.B**'s were sown, none proved to be pure or stable like no. 1 of fig. 2. But in the offspring of a di-hybrid the chances are that only one in nine, that have the form **A.B**, will turn out to be that in reality.

I much regret that the experiment was not conducted on a larger scale; but it should be borne in mind that the object was not to verify the Laws of Mendel,— that is now quite unnecessary; but, conversely to prove that as these seedlings in their metamorphoses obey the laws of Mendel, their parent was of hybrid origin. Disappointed in my expectation that the artificial production of violet hybrids would be attempted at a certain 'biological laboratory,' it occurred to me over two years ago that equally valuable results might be gotten by observing the behavior of the offspring of the supposed

hybrids. As pointed out by Dr. McDougal,[1] the test of a suspected natural hybrid may often be better made by the Method of Analysis than by the Method of Synthesis. In the genus Viola the analytic method has proved unexpectedly successful. Over thirty putative hybrids have produced offspring that segregate in accordance with Mendelian principles.

An objection recently made to the occurrence of hybrids in Viola is based on the supposed fact "that 99 out of 100 seeds of these plants"[2] are from self-fertilized flowers. This led me last June to examine with reference to this matter plants of some eighteen species of our stemless violets, and revealed the fact that all but two of these plants produced seed freely from the petaliferous flowers; in some instances over 300 such seeds were produced by a single plant.[3] The structure of the flower, in style stamens and petals, shows a most ingenious arrangement to prevent self-pollination; and it is now evident that the ovules are readily fertilized by the pollen of an allied species. The coexistence of this habit with the opposite habit of producing in summer self-fertilized flowers is apparently the cause of the multiplicity of forms in this group of plants. Hybridism gives rise to numerous intergradient types; cleistogamy preserves them from further intermixture more skilfully than the artificial hybridizer with his paper bags, and permits the laws of Mendel to work out their natural results, giving rise often to new varieties and races. The behavior of violet hybrids and their offspring under cultivation presents many striking illustrations of this procedure, and awakens the hope that with this clew to guide us we may solve some of the long-standing perplexities of the genus.

Middlebury, Vermont.

[1] Hybridization of Wild Plants, Bot. Gazette xliii. 11–44, Jan. 1907.
[2] Prof. E. L. Greene, Leaflets i. 214.
[3] Five plants of *V. nephrophylla* furnished at one time from the capsules of petaliferous flowers 1227 ripe seeds.

PRIMULA FARINOSA, VAR. MACROPODA ON THE MAINE COAST.

Joseph A. Cushman.

While I was collecting on the coast of Maine about Machias Bay in early August my attention was called to the occurrence of a peculiar plant said to be found at the base of the lighthouse on Libby Islands. It was thought to have been brought there by birds which frequently fly against the lighthouse and are killed. To see what this plant might be I visited the island with Mr. S. N. F. Sanford and found the plant in very considerable numbers. It proved to be *Primula farinosa* L., var. *macropoda* Fernald. The only places where it occurred were at the base of the lighthouse and the ground about the oil-house nearby. At the time of collecting, the plants were in excellent fruit and certainly seemed thoroughly established. They were growing in loose sandy loam well grassed over. From its appearance it was soil which had been added there by grading and was not in its original position.

From the occurrence of the plants it seemed in every way probable that the seeds were brought, as was first told us, by birds coming from farther north. As is well known, many birds are killed by flying against lighthouses at the various exposed points along the coast. The very limited occurrence about the lighthouse seems to be explained only in this way.

After visiting the island we studied the chart of the region and decided to make a trip to Moose Peak Light on Mistake Island. This is the outer exposed point of the northeastern chain of islands extending out from Jonesport. This was in the direction which birds would probably take in migration. If the theory of the source of the other station was true it seemed as though the plant should be found there also. A day or two later we visited Mistake Island and were much pleased to find the plant there though the individuals were much fewer in number. It was growing near the light on moist granitic cliffs but in considerable soil. On the same day we also landed at Black Head on the outer part of Head Harbor Island. On the summit were found scattered specimens of the same plant. These were growing in wet grassy spots among the rocks and appeared more likely to be indigenous than in either of the other places visited. It was planned to visit Nash Island still farther to the southwest but time and

weather conditions prevented our doing so. In all, three stations were discovered for this plant. These are of especial interest as the only other New England station was Mt. Kineo, Moosehead Lake, Maine. Although I collected on Mt. Kineo about three weeks later and made a point of looking for this plant no trace of it was found but I have since been informed by Dr. Kennedy that his specimens were found at the eastern end of the cliffs at a spot I did not reach.

From our observations it would seem likely that the plant may be found about the lighthouses still farther to the southwest along the outer points of the Maine Coast.

Boston Society of Natural History.

NOTEWORTHY PLANTS COLLECTED AT ROQUE BLUFFS, MAINE, IN 1907.

C. H. Knowlton.

During the past summer I spent several days collecting in Washington County, Maine, mostly in the township of Roque Bluffs. This lies on the coast, 16 miles from Cutler, and 22 from Mt. Desert. The summer climate there is cool and very wet, because the Greenland current washes the shore and causes frequent fogs.

The coast is lined with cliffs of volcanic rock, broken by occasional sea-caves, estuaries and beaches. In many places heavy spruce woods come down to the edge of the sea-cliffs, with such typical plants of the northern mountain woods as *Solidago macrophylla*, Pursh, and *Aspidium spinulosum* (O. F. Mueller) Sw. var. *dilatatum* (Hoffm.) Hook. forma *anadenium* B. L. Robinson.

Back from the cliffs are numerous and extensive peat-bogs, covered with *Picea nigra* Link., *Eriophorum callitrix* Chamisso, *Smilacina trifolia* Desf., *Empetrum nigrum* L., *Rubus Chamaemorus* L., *Vaccinium Oxycoccus* L., and more common bog plants.

I have not fully explored the region, and the estuaries in particular will probably reward further search. The following species already collected, however, seem worthy of mention.

Elymus mollis Trin. is a common beach grass, growing in the same sandy soil as *Ammophila arundinacea*, Hostk.,— but not so abundant.

Iris setosa Pall. Very common within reach of spray from the sea, but never competing with *I. versicolor* L., inland.

Comandra livida Richards. Very common on Johnson's Beach bog, with *Rubus Chamaemorus* L., but there were no blossoms or fruit visible (July 6). This is the first New England station at sea level, as the other reports are from five granitic mountain tops (Mansfield, Clinton, Saddleback, Abraham and Katahdin). It occurs at sea level in New Brunswick and northward.

Suaeda Richii Fernald. Common along the edges of the salt marshes.

Montia fontana L. Moist open woods, Roque Island.

Empetrum nigrum, L. var. *andinum* DC. Common on the top of the sea-cliffs, in residual gravel, the branches frequently hanging down. The typical form of the species seems to grow only in peat-moss. (RHODORA, IV, 196.)

BOSTON, MASS.

NOTOTHYLAS ORBICULARIS IN MASSACHUSETTS.— On October 9, 1907, while collecting with a class in Cryptogamic Botany, on the Wellesley College campus, I found a number of plants of *Notothylas orbicularis* (Schwein.) Sulliv. The *Notothylas* was growing on wet sandy soil, in company with *Anthoceros*, and equally abundant. Dr. A. W. Evans has confirmed my identification of the material.

As there seem to be few specimens in herbaria, it may be worth while to record what is known of Massachusetts stations for the plant. Dr. Evans states that the only Massachusetts specimens, of which he knows, were collected at Cambridge, and are in the Underwood Herbarium. There is but one specimen in the Cryptogamic Herbarium of Harvard University, having been collected by Dr. Farlow at Newton, in a locality where now probably extinct. In addition to these specimens, Dr. Evans has found *Notothylas* at Falmouth, Dr. Farlow at Cambridge, and Dr. Thaxter at Waverley. In none of these cases, however, was material preserved. To these should now be added the Wellesley locality. Specimens of this collection have been deposited in the Herbarium of Wellesley College, in the Herbarium of Dr. A. W. Evans, at Yale University, and in the Cryptogamic Herbarium of Harvard University.

The records from the localities named above suggest that *Notothylas* is probably well distributed through Massachusetts and perhaps

further north, but has been overlooked. It, therefore, seemed well to call the attention of New England botanists to the plant, that they may watch for it in future collecting, and give us more exact knowledge of its distribution.— Lincoln Ware Riddle, Wellesley College, Wellesley, Massachusetts.

Rediscovery of Podostemon ceratophyllus in Vermont.— While crossing the West River about one fourth mile below the railroad station in Jamaica, Vermont, one day the past summer, my attention was attracted by a curious sea-weed like plant which adhered closely to the stones of the river bed, and which seemed to be abundant over a considerable area. It being the dry season (August) some stones bearing the plant were out of water. Upon being submitted to the Harvard Botanical Department the plant proved to be the river weed *Podostemon ceratophyllus* Michx. This plant has before been reported from Vermont by Frost but has been placed upon the doubtful list in the Flora of Vermont. The station is only accessible at low water but no doubt the plant may be found at other places in the bed of West River.— Frank Dobbin, Shushan, New York.

A new Variety of Scirpus Olneyi.— The genus *Scirpus* is somewhat remarkable for the number of its varieties with elongated spikelets, so it was not surprising when, in Milford, Conn., Sept. 28, 1907, during an excursion of the Connecticut Botanical Society, the writer found an additional variety of this class, which may be described as follows:—

Scirpus Olneyi Gray, var. **contortus,** n. var. Some or all of the spikelets twisted or bent, linear, elongated (1–2, rarely 2.4 cm. in length); involucral leaf prolonged (3–7 cm.) and, like the stem, not so stout as in the species. Brackish marsh on the coast, Milford, Conn., *E. H. Eames*, no. 5847. Type, in herb. Eames: co-type in herb. Gray.

Conspicuously different from the species in the foregoing characters; and from allied species, among other features, in the remarkable triquetrous-winged stem.— E. H. Eames, Bridgeport, Connecticut.

Vol. 9, no. 106, including pages 197–208 and plate 76, was issued 26 October, 1907.

Rhodora

JOURNAL OF

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Vol. 9. December, 1907. No. 108.

SOME NEW WILLOWS OF EASTERN AMERICA.

M. L. Fernald.

Recent explorations of the eastern portion of the Province of Quebec have brought to light many willows which have hitherto been unknown in eastern America. Some of these shrubs, such as *Salix pseudo-myrsinites* Anders., *S. Barclayi* Anders., and *S. fuscescens* Anders., have been previously known only from the northwestern Provinces or from Alaska; the unique *S. Richardsoni* Hook., var. *Macouniana* Bebb has been known only from Hudson Bay and northern Labrador; while some others it has been impossible to identify with any described species or varieties.

The most abundant of these undescribed willows are two large shrubs or small trees which abound on the terraces and banks of the St. Lawrence at least from Matane to the River Ste. Anne des Monts, and probably beyond, and for several miles inland in the valley of that river. One of these trees, which in its best development is about 15 feet high, with wide-spreading branches, has the largest leaves known to the writer in any member of the *Diandrae*, the mature blades often reaching a length of 5 or 6 inches. This handsome large species may appropriately be called

Salix **laurentiana** n. sp. Frutex altus vel arbor mediocris, ramis crassis junioribus canescento-tomentosis; foliis oblongis vel oblongo-obovatis acutis vel breviter acuminatis junioribus dense albo-pubescentibus, demum supra glabris viridibus lucidis subtus glaucescentibus 6–14 cm. longis 3–4.5 cm. latis subintegris vel leviter crenatis, petiolis gracilibus circa 1.5 cm. longis tomentosis; stipulis late ovatis deciduis; amentis gracilibus pedunculatis foliis parvis 3–5 suffultis patulis, femineis densifloris fructiferis 4–9 cm. longis 1 cm. crassis; squamis oblongis obtusis fuscis longe pilosis; capsulis conico-subulatis obtusis canescento-tomentosis 5–6 mm. longis pedicellatis, pedi-

cello nectarium triplo superante; stylo brevissimo, stigmatibus bifidis.

Large shrub or small widely branching tree, 2–5 m. high; branchlets coarse, canescent-tomentose, the pubescence slightly lustrous; leaves oblong to oblong-obovate, at first silky-tomentose on both surfaces, in maturity bright green and glabrate above, glabrate and glaucous beneath, 6–14 cm. long, 3–4.5 cm. broad, subentire or shallowly crenate, acute or short-acuminate, rounded at base to the tomentose petiole (about 1.5 cm. long); stipules round-ovate, deciduous; aments borne upon short leafy branches, the pistillate dense, on canescent peduncles, 4–9 cm. long, about 1 cm. thick; scales oblong, obtuse, dark brown, long-pilose; capsule conic-subulate, blunt, canescent-tomentose, 5–6 mm. long; pedicel 1–2 mm. long, thrice as long as the nectary; style 0.5 mm. long, the stigmas deeply cleft.— Quebec, abundant on terraces and banks of the St. Lawrence River from Matane, Matane Co., to Ruisseau Castor, Gaspé Co., and probably eastward. Type material: in fruit, Méchins, Gaspé Co., July 12, 1906 (*Fernald & Collins*, no. 202); in mature foliage, calcareous-sandstone sea-cliffs, Tourelle, Gaspé Co., August 19–21, 1905 (*Fernald & Collins*).

A handsome and very characteristic large-leaved shrub or small tree, suggesting in its foliage and tomentose branchlets *S. amplifolia* Coville, of Alaska, which has slightly smaller leaves, no stipules, thicker aments (1.5–2 cm. in thickness), the ovary and capsule smooth, and the style 3–4 mm. long. From the eastern *S. glaucophylla*, which abounds along the rivers of northern Maine, New Brunswick and Quebec, *S. laurentiana* is, likewise, immediately distinguished by its tomentose capsules, as well as the aments terminating leafy twigs instead of being sessile or subsessile upon the old wood.

The other undescribed willow which is associated on the banks of the lower St. Lawrence with *S. laurentiana*, *S. pellita* Anders., *S. lucida*, var. *intonsa* Fernald, and *S. rostrata* Richardson, has a wider distribution than *S. laurentiana*, for it has been observed in abundance up the river from Matane as far as St. Fabien in Rimouski County and it doubtless extends further west. This large shrub or small tree, sometimes 20 feet high with trunks 6 inches in diameter, is clearly an extreme variation of the common *S. rostrata*. In the typical form of the species as well as in such variations as I find described the leaves are more or less rugose and comparatively small, the mature pedicels are from 3 to 5 mm. long, and the capsules 5 to 9 mm. long. The larger extreme of the species from the lower St. Lawrence may be called

Salix rostrata Richardson, var. **luxurians** n. var. Arbor 2–6 m. alta, trunce 1–1.5 dm. crasso; foliis planis non rugosis 6–10 cm. longis; amentis femineis 2.5–3 cm. crassis, pedicellis 5–8.5 cm. longis; capsulis 9–12 mm. longis.

Tree 2–6 m. high, the larger trunks 1–1.5 dm. in diameter, with the nearly plane scarcely rugose leaves becoming 1 dm. long in maturity; mature pistillate aments very large, 2.5–3 cm. thick; pedicels 5–8.5 mm. long; capsules 9–12 mm. long.— Quebec, abundant on banks of the St. Lawrence from Rimouski Co. to Gaspé Co. Type material: limestone ledges, Bic., July 4–6, 1906 (*Fernald* & *Collins*, nos. 208, 495).

Along the gravelly half-inundated margin of the River Ste. Anne des Monts occurs an unusually attractive little shrub, its slender smooth branches rarely more than 2 or 3 feet high and its short oblong or suborbicular dentate leaves suggesting to the casual observer the foliage of the common *Amelanchier spicata* (Lam.) C. Koch. (*A. rotundifolia* Roem.) of the region, rather than that of any of our willows. Prolonged study fails to show any American willow to which it is nearly related, but in foliage as well as in its sessile aments the shrub very strongly suggests the little known Siberian *Salix pyrolaefolia* Ledeb. as shown in Ledebour's beautiful plate. From that unique species the shrub of the Ste. Anne River differs in several important characters enumerated below, and it seems sufficiently distinct to merit the name

Salix **obtusata** n. sp. Frutex parvus, ramis gracilibus castaneis glaberrimis; foliis oblongis vel terminalibus suborbiculatis 2–5 cm. longis 1–3 cm. latis dentato-serratis apice rotundatis basi rotundatis vel subcordatis junioribus arachnoideis tenuissimis pellucidis purpurascentibus demum coriaceis glabris supra viridibus subtus pallidioribus, petiolis gracilibus 5–12 mm. longis; stipulis cordatis persistentibus majoribus 5 mm. longis obscure glanduloso-dentatis; amentis sessilibus, femineis 5–20 mm. longis; squamis oblongo-ovatis obtusis subfuscis laxe villosis; capsulis glabris conico-subulatis rufescentibus vel flavescentibus 2–3 mm. longis breviter pedicellatis, pedicello nectarium valde superante; stylo parvo, stigmatibus minimus bifidis.

Low slender shrub (0.5–1 m. high): branchlets slender, glossy brown, glabrous: leaves oblong to suborbicular, 2–5 cm. long, 1–3 cm. broad, closely dentate-serrate, rounded or subcordate at base, rounded at apex, glabrous, or the youngest arachnoid-tomentose, at first thin and purple-tinged; later coriaceous, bright green above, slightly glaucous beneath; petiole slender, 5–12 mm. long: stipules cordate, persistent, the largest about 5 mm. long, obscurely glandular-

dentate: aments sessile upon the old wood, the pistillate short-cylindric, 0.5–2 cm. long: scales oblong-obovate, obtuse, brownish, loosely villous: capsule glabrous, conic-subulate, reddish or yellowish, 2–3 mm. long: pedicel 0.5 mm. long, much exceeding the very short nectary: style very short, the stigmas bifid; staminate aments not seen.— Quebec, inundated gravelly bars and beaches, River Ste. Anne des Monts, fruit July 15, 1906, mature foliage August 16, 1906 (*Fernald & Collins*, nos. 203, 203a).

Closely allied to and strongly simulating the Siberian *S. pyrolaefolia* Ledeb. but differing in its more shallowly toothed leaves, shorter sessile aments and very short style. The type specimens were collected from characteristic low shrubs associated with a number of other willows — *S. cordata, S. pellita, S. glaucophylla,* &c.— at the frequently inundated margins of a group of alluvial islands near the head of the Grand Rapids of the River Ste. Anne des Monts.

Salix fuscescens Anders., hitherto known only from northern and western Alaska and the adjacent coast of Siberia, is abundant in bogs on the serpentine tableland of Mt. Albert. It is a very attractive creeping shrub, in foliage and other characters strongly suggesting *S. pedicellaris* Pursh of our northern temperate regions (*S. myrtilloides* of American authors, not L.). From the lowland species, *S. fuscescens* is quickly distinguished by its usually obovate leaves, the more pubescent scales of the aments, the very short thickish pedicels (barely exceeding the scales), the long subulate nectary which is usually half as long as the pedicel, and the definite though short style. As stated, this attractive species is abundant in the bogs of Mt. Albert, where it is associated with numerous other plants typical of western and northern Alaska and adjacent Siberia —*Eriophorum Chamissonis* C. A. Meyer, *Conioselinum Gmelini* (C. & S.) Coulter & Rose, *Festuca altaica* Trin., &c.,— and although many colonies have the capsules quite glabrous as in the type of the species, others occupying extensive areas of bog, have the capsules distinctly pilose. These shrubs with pilose capsules seem otherwise identical with typical *S. fucescens* and they may be designated

Salix fuscescens Anders., var. **hebecarpa** n. var. Frutex parvus, ramis subflagelliformibus; foliis amentisque eis formae typicae similibus; capsulis pilosis.

Capsules pilose; characters otherwise as in the typical form.— Quebec, alpine bog, tableland of Mt. Albert, Gaspé Co., July 21, 1906 (*Fernald & Collins*, no. 207).

While studying the specimens and descriptions of Labrador willows the writer has often wondered that *Salix adenophylla* should have been described as a unique species from Labrador and that we should now know the plant only from the sand dunes of the Great Lakes. A careful study of Hooker's original description of *S. adenophylla* and of Andersson's fuller descriptions of the type material shows that the shrub of the Great Lakes can have no close affinity with *S. adenophylla* and it is here proposed as

Salix **syrticola** n. sp. Frutex altus vel mediocris laxe procumbens, ramis crassis cinereo-tomentosis vel puberulis; foliis ovatis vel late lanceolatis acuminatis cordatis vel subcordatis crebre glanduloso-serrulatis junioribus sericeo-lanatis demum firmis viridibus opacis lanatis vel glabratis 3–10 cm. longis 2–5 cm. latis, petiolis brevibus latis cinereo-pubescentibus; stipulis conspicuis foliaceis cordato-ovatis glanduloso-serrulatis petiolos valde superantibus; amentis pedunculatis foliis patulis 3–6 suffultis, masculis 2.5–4.5 cm. longis circa 1 cm. crassis, femineis 2–4.5 demum 5–10 cm. longis 1–1.5 cm. crassis; squamis oblongis fulvis valde tomentosis vel longe sericeis; capsulis conico-subulatis glabris rufescentibus 5–7 mm. longis basi rotundatis vel subcordatis pedicellatis, pedicello glabro 0.5–1 mm. longo nectarium prope triplo superante; stylo 0.5–1 mm. longo, stigmatibus vix bifidis.

Large straggling shrub: branchlets stout, cinereous-tomentose or -puberulent; leaves ovate to broadly lanceolate, acuminate, cordate or subcordate, closely glandular-serrulate, silky-lanate when young, often becoming glabrate, in maturity firm, dull green, 3–10 cm. long, 2–5 cm. broad; petioles short and broad, dilated at base, cinereous-pubescent: stipules conspicuous, foliaceous, cordate-ovate, glandular-serrulate, much exceeding the petioles: bud-scales cinereous-tomentose: aments appearing with the leaves, on leafy-bracted peduncles, the bracts 3–6, resembling the leaves; staminate aments 2.5–4.5 cm. long, about 1 cm. thick; pistillate 2–4.5, becoming in fruit 5–10 cm. long, 1–1.5 cm. thick: scales oblong, pale brown, very densely long-silky or tomentose: capsule conic-subulate, glabrous, rufescent, 5–7 mm. long, rounded or subcordate at base: pedicel glabrous, 0.5–1 mm. long, nearly twice as long as the nectary: style 0.5–1 mm. long; stigmas obscurely bifid: stamens 2, the filaments glabrous.— *S. adenophylla* Bebb, The Lens, ii. 249 (1873), and in Gray, Man. ed. 6, 485 (1890); Britton in Britton & Brown, Ill. Fl. i. 504, fig. 1203 (1896); not Hook. Fl. Bor. Am. ii. 146 (1839).— Sand dunes and beaches along the Great Lakes. A sheet in the Gray Herbarium from sandy shores of Lake Michigan, near Chicago, *H. H. Babcock*, 1880 (Bebb, Herbarium Salicum, no. 2) may serve as the type.

This handsome shrub is one of the best marked species in the group,

and apparently only through his extreme caution in characterizing new species was it allowed by Mr. Bebb to pass so long for the little known *Salix adenophylla* Hook. Hooker's species from Labrador is still known only from the original specimens and descriptions, but so many of the older and hitherto obscure northern species have recently come to light that we may confidently hope soon to understand more clearly *S. adenophylla*. At present our best information upon this species is that given in the original description by Hooker and later from the type material by Andersson. It is noteworthy that Hooker, following the system of Barratt, placed his Labradorean *S. adenophylla* immediately after *S. speciosa* and *S. Barrattiana* (two of our most remarkable willows, with the large aments chiefly sessile at the tips of the old branchlets) and not in the section with *S. cordata* to which *S. syrticola*, the shrub of the Great Lake region, is clearly related.

The original description of *S. adenophylla* gives account of little besides the leaves: "foliis ovatis basi cordatis acutis . . . . argute serratis serraturis elongatis glanduliferis . . . . stipulis ovato-cordatis grosse glanduloso-serratis"; [1] but that the elongate glanduliferous serratures were sufficient in Hooker's mind to distinguish the species is shown by his note: "I know no species like this, well marked as it is by the copious long narrow serratures to the leaves tipped with a gland, so that the leaf looks as if it were fringed with pedicellated glands." [1] This remarkable character of the foliage is sufficient, even if the habitat, Labrador, were not almost convincing, to show that Hooker's plant could not have been the same as the common sand dune shrub of the Great Lakes; and when we refer to Andersson's account [2] of the Hookerian type, we find added corroboration in the statements of other characters: "folia . . . . majora pollicem longa" (in *S. syrticola* the larger are a full decimeter — 4 inches — long, and the smallest examined are 3 cm. long); the fully mature fruiting ament "1½ poll. longa" (in *S. syrticola* 5–10 cm. — 2–4 inches); "squamis . . . . glabriusculis" (in *S. syrticola* very densely and persistently long-silky or tomentose); "pedicello cinereo" (in *S. syrticola* glabrous and straw-colored).

Gray Herbarium.

[1] Hook. Fl. Bor.-Am. ii. 146 (1839). [2] DC. Prodr. xvi. 254 (1864).

New Stations for Two Vermont Plants.— This season I found beside the road, near the long bridge across West River, about a mile above Townshend village, a plant which proved to be *Berteroa incana*, DC. It was growing in considerable abundance in a light sandy field.

Up to the time of the publication of the Brainerd, Jones, and Eggleston's Flora of Vermont this plant had been reported from but three stations in the state.

I have found *Sisymbrium altissimum*, L. in two places in Jamaica this season: one in our strawberry field and again in a neighbor's door-yard. Mr. Dobbin of Shushan, New York, while in town this year, found it beside the railroad above Jamaica depot. This also seems to be one of the infrequent but increasing Vermont plants.— Leston A. Wheeler, Jamaica, Vermont.

NEW ENGLAND SPECIES OF PENIUM.

Joseph A. Cushman.

Species of the genus *Penium* cannot be called common in New England although specimens are usually met with in nearly all gatherings of Desmids of any richness. Many of the species are inconspicuous and a few of them minute. Twenty-eight species are known from the British Isles while but twelve are recorded here from New England. Two of these are recorded here for the first time. The forms which have not been previously recorded are preceded by an asterisk. All records for which specimens have been seen are followed by an exclamation point. A brief synonymy is given to clear up some of the names used in American works and to give references to published figures. A key is given to the species recorded here, based upon that of the Wests. Measurements and descriptions unless otherwise stated are based upon New England specimens.

PENIUM Bréb., 1844.

Cells straight, usually cylindrical or fusiform, with or without a slight median constriction; each semicell with a single axile chloro-

plast with radiating plates, entire at the outer edges, each chloroplast with one or more pyrenoids, when several, in an axile series; cell wall usually with pores.

Key to the New England Species of Penium.

- I Cells unconstricted, smooth.
  - 1. Cells large, breadth 20–50 μ . . . . . *P. Libellula.*
  - 2. Cells small, breadth 10–15 μ . . . . . *P. Navicula.*
- II Cells usually constricted in the middle.
  - 1. Cell wall granulate.
    - A. Cell wall granulate over its entire surface.
      - a. Cells large, usually more than 100 μ long *P. margaritaceum.*
      - b. Cells minute, usually less than 30 μ long . *P. cuticulare.*
    - B. Granules restricted to the ends of the cell . . *P. Clevei.*
  - 2. Cell wall striated.
    - A. Cells large, striations distinct, spirally arranged *P. spirostriolatum.*
    - B. Cells small, striations longitudinal and indistinct.
      - a. Breadth usually more than 20 μ . . *P. polymorphum.*
      - b. Breadth usually less than 20 μ . . *P. phymatosporum.*
  - 3. Cell wall smooth or punctate.
    - A. Cells 2–4 times as long as broad.
      - a. Cell wall punctate . . . . . . *P. curtum.*
      - b. Cell wall smooth . . . . . . *P. cruciferum.*
    - B. Cell elongate, many times as long as broad . *P. minutum.*
  - 4. Cell with annulations . . . . *P. annulare.*

Penium Libellula (Focke) Nordst.

Closterium Libellula Focke, Physiologische Studien, 1847, p. 58, pl. 3, fig. 29.

Penium Libellula Nordst., Videnskab. Meddel. f. d. naturh. Foren. i. Kjöbenhavn, 1888. p. 184; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 73, pl. 7, figs. 6, 7.

Penium closterioides Ralfs, Brit. Desm., 1848, p. 152, pl. 34, fig. 4; Wood, Smithson. Contrib. to Knowl. No. 241, 1874, p. 109; Wolle, Desm. U. S., 1884, p. 35, pl. 5, fig. 18.

Cells large, 4½–6½ times as long as wide, fusiform, no constriction, ends subtruncate, polar vacuoles with several moving granules.

Length 186–233 μ; maximum breadth 38–50 μ.

N. H.: Intervale, scarce! Pudding Pond, North Conway, common!

North Woodstock, common! Mass.: Medford! Bridgewater! East Bridgewater! Lake Watuppa, Fall River!

Penium Libellula, var. interruptum (West) W. & G. S. West.

Penium closterioides, forma *interrupta* West, Journ. Roy. Micr. Soc., 1892, p. 721.

Penium Libellula, var. *interruptum* W. &. G. S. West, Journ. Roy. Micr. Soc., 1897, p. 479; Brit. Desm., vol. 1, 1904, p. 74, pl. 7, figs. 9, 10.

Smaller than the typical form, the chloroplasts divided three times transversely, therefore in each cell four chloroplasts each containing a pyrenoid.

Length 120–170 μ; breadth 22–37 μ.

N. H.: Pudding Pond, North Conway! Mass.: Pondville! Plainville!

Penium Libellula, var. intermedium Roy & Biss.

Penium Libellula, var. *intermedium* Roy & Biss., Ann. Scot. Nat. Hist., No. 12, Oct. 1894, p. 252; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 74, pl. 7, fig. 11.

Differs from the typical form in size, being about one half the size, otherwise typical.

Length 124 μ; breadth 22 μ.

Mass.: Pondville!

Penium Navicula Bréb.

Penium Navicula Bréb., Mem. d. l. soc. imp. sc. nat. Cherbourg, vol. 4, 1856, p. 146, pl. 2, fig. 37; Wolle, Desm. U. S., 1884, p. 36, pl. 5, fig. 16; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 75, pl. 7, fig. 12–15, 19.

Cells small, $3\frac{1}{2}$–$4\frac{1}{2}$ times as long as wide, fusiform, no constriction, ends broadly rounded, vacuoles with two or three moving granules.

Length 55–60 μ; breadth 14 μ.

Me.: Orono (*W. West*); Mass.: Plainville! Lake Watuppa, Fall River!

Penium margaritaceum (Ehrenb.) Bréb.

Closterium margaritaceum Ehrenb., Die Infusionthierchen als volkommene Organismen, 1838, p. 95, pl. 6, fig. XIII.

Penium margaritaceum Bréb., in Ralfs. Brit. Desm., 1848, p. 149, pl. 25, fig. 1, *a–c*; Wood, Smithson. Contrib. to Knowl. No. 241, 1874, p. 107; Wolle, Desm. U. S., 1884, p. 34, pl. 5, figs. 5, 6, 11; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 83, pl. 8, figs. 32–35.

Cells 7–11 times as long as wide, cylindrical, median constriction present, ends broadly or truncately rounded, cell wall with granules arranged in longitudinal rows, reddish or yellowish brown in color.

Length 120–240 μ; breadth 17–22 μ; apices 12–15 μ.

Me.: Orono (*Harvey*), Kittery, not common! N. H.: Plymouth (*Wests*); Pudding Pond, North Conway! Intervale! Vt.: (*Wolle*); Mass.: Amherst (W. West); Lake Quinsigamond, Worcester (*Stone*); Bridgewater! Lake Watuppa, Fall River! R. I.: Wainskut Pond, North Providence (Bailey); Conn.: (*Wolle*).

This is one of our most striking species and easily noted, yet cannot be called common.

* PENIUM CUTICULARE W. & G. S. West.

Penium cuticulare W. & G. S. West, Journ. Roy. Micr. Soc., 1896, p. 153, pl. 4, figs. 43, 44; Brit. Desm., vol. 1, 1904, p. 85, pl. 6, figs. 4, 5.

Cells minute, 2½ times as long as wide, cylindrical, no constriction, ends broadly and truncately rounded, cell-wall reddish brown, minutely but irregularly papillose.

Length 22 μ; breadth 9.3 μ.

Mass.: Lake Watuppa, Fall River!

PENIUM CLEVEI Lund., var. CRASSUM W. & G. S. West.

Penium Clevei Lund. Desm. Suec., 1871, p. 86, pl. 5, fig. 11; var. *crassum* W. & G. S. West, Journ. Roy. Micr. Soc., 1894, p. 4, pl. 1, fig. 5; Brit. Desm., vol. 1, 1904, p. 88, pl. 8, fig. 38; Cushman, Bull. Torrey Club, vol. 32, 1905, p. 225, pl. 7, fig. 8.

Cells about twice as long as wide, lateral margins decidedly convex, slightly constricted in the middle, ends of the cell finely granulate, chloroplast with a single large pyrenoid. Zygospore spherical, with numerous broad, squarely truncated processes.

Length 80–96 μ; breadth 40–44 μ; isthmus 38.5–40 μ; breadth of zygospore with processes 68–78 μ: without processes 54–57 μ.

Mass.: Pondville!

This is the only record for the zygospore of this species.

PENIUM SPIROSTRIOLATUM Barker.

Penium margaritaceum, var. *punctatum* Ralfs, Brit. Desm., 1848, p. 149, pl. 25, figs. 1, *d–h*.

Penium spirostriolatum Barker, in Quart. Journ. Micr. Sci., vol. 9, 1869, p. 194; Wolle, Freshw. Alg. U. S., 1887, p. 22, pl. 61, fig. 19; G. S. West, Journ. Linn. Soc. Bot., vol. 34, 1899, p. 377–380; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 88, pl. 9, figs. 1–8.

Cells large, about 9 times as long as wide, cylindrical, with a slight median constriction, slightly attenuated toward the rounded apices, transverse sutures apparent, cell wall yellowish brown, marked with longitudinal striae, variably twisted especially near the ends of the cell.

Length 202–233 μ; breadth 19–25 μ; apex 15–16 μ.

Me.: Orono (*W. West*); Mass.: Winchester! Lake Watuppa, Fall River!

* PENIUM SPIROSTRIOLATUM, var. **apiculatum** var. nov.

Cells about four times as long as wide, central portion cylindrical, at each end very abruptly narrowed for about one-sixth of the length.

Length 84 μ; breadth 21 μ; apices 11.5 μ.

Mass.: Plymouth!

PENIUM POLYMORPHUM Perty.

Closterium polymorphum Perty, in Bern. Mitth. 1849, p. 28.

Penium polymorphum Perty, Kleinist Lebensf., 1852, p. 207; Wolle, Desm. U. S., 1884, p. 36, pl. 5, fig. 12; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 90, pl. 9, figs. 9–11.

Cells small, about 2½ times as long as wide, cylindrical with a slight median constriction, very slightly attenuated toward the broadly rounded apices, cell-wall with inconspicuous, longitudinal striations.

Length 50 μ; breadth 20 μ.

Vt.: Charlotte (*Wolle*); N. H.: Pudding Pond, North Conway, occasional! Mass.: Amherst (*W. West*).

PENIUM PHYMATOSPORUM Nordst.

Penium phymatosporum Nordst., Desm. Ital., 1876, p. 26, pl. 12, fig. 1; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 91, pl. 6, figs. 9–11.

Cells small, about 2¼ times as long as wide, with a very slight constriction, very slightly attenuated toward the truncately rounded apices, cell wall with delicate longitudinal striations.

Length 35–40 μ; breadth 15.5–16.5 μ; isthmus 13.5 μ.

Mass.: Tom Never's Pond and pond near Old North Cemetery, Nantucket!

Penium curtum Bréb.

Closterium curtum Bréb., in Desm., 1838, fasc. 19, No. 901.

Cosmarium curtum Ralfs. Brit. Desm., 1848, p. 109, pl. 32, fig. 9.

Penium curtum Bréb., in Kütz., Spec Alg., 1849, p. 167; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 97, pl. 10, figs. 21, 22.

Calocylindrus curtus Wolle, Desm. U. S., 1884, p. 54, pl. 12, figs. 15, 16.

"Cells small, sometimes minute, a little more than twice longer than their diameter, with a distinct median constriction; semi-cells attenuated, sides convex, apex rounded and sometimes slightly thickened; cell wall punctate; chloroplasts with about eight longitudinal ridges."

Length 22–60 μ; breadth 10.5–32.5 μ; breadth of isthmus 9.5–30 μ.

Mass.: Amherst (*W. West*).

Personally I have not met with this species in New England. It has been found in Massachusetts by West and in several states outside of New England by Wolle. The description and measurements are from the Wests' British Desmids.

* Penium cruciferum (DeBary) Wittr.

Cosmarium? cruciferum DeBary, Conj., 1858, p. 72, pl. 7, G, figs. 3–6.

Penium cruciferum Wittr., in Wittr. & Nordst., Alg. Exsicc. No. 482, 1882; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 100, pl. 10, figs. 18, 19.

Cells small, about 1½ times as long as wide, with a slight median constriction, apices broadly rounded, cell wall smooth and colorless.

Length 15.5 μ; breadth 10 μ; isthmus 9.3 μ.

Mass.: Lake Watuppa, Fall River, common!

Penium minutum (Ralfs) Cleve.

Docidium minutum Ralfs., Brit. Desm., 1848, p. 158, pl. 26, fig. 5; Wolle, Desm. U. S., 1884, p. 52, pl. 10, fig. 9, pl. 50, figs. 29–31.

Penium minutum Cleve, Ofvers. af K. Vet.-Akad. Förh., 1864, p. 493; Wolle, Desm. U. S., 1884, p. 35, pl. 5, figs. 19, 20; W. & G. S. West, Brit. Desm., vol. 1, 1904, p. 101, pl. 10, figs. 1, 2.

Calocylindrus minutus Wolle, Desm. U. S., 1884, p. 54, pl. 5, figs. 19, 20, pl. 12, fig. 12.

Cells elongate cylindrical, 8–12 times as long as wide, with a clearly defined median constriction, gradually attenuated to the truncate apices, cell wall colorless, smooth or punctate.

Length 114 μ; breadth 13 μ.

Mass.: Lake Quinsigamond, Worcester (*Stone*); Tewksbury (*Lagerheim*); R. I.: (*Bailey*).

I have not as yet found the typical form in New England. The measurements are those given by Lagerheim of a Massachusetts specimen.

Penium minutum, var. elongatum W. & G. S. West.

Penium minutum, var. *elongatum* W. & G. S. West, Trans. Linn. Soc. Ser. 2, Bot. vol. 6, no. 3, 1902, p. 136; Brit. Desm., vol. 1, 1904, p. 104, pl. 10, fig. 8.

Cells much longer than in the typical form, 40 times as long as wide.

Length 372 μ; breadth 9 μ.

N. H.: Pudding Pond, North Conway!

Penium annulare West.

Penium annulare West, Journ. Bot., vol. 29, 1891, p. 354, pl. 315, figs. 5, 6; Johnson, Bull. Torrey Club, vol. 21, 1895, p. 290, pl. 239, fig. 1.

"Penium of medium size, about 7 times as long as wide, subcylindrical, with median constriction (or subconstricted), gradually attenuated from the middle to the subtruncate apices, with distinct annulations (about 14–22): in end view circular; cell wall colorless, densely and irregularly punctate."

Length 130–177 μ; breadth 20–23 μ.

Me.: Scarbro', abundant (*W. West*). This is the type locality.

Penium annulare, var. obesum West.

Penium annulare, var. *obesum* West. Journ. Bot., vol. 29, 1891, p. 354, pl. 315, fig. 7.

"Variety about 3 times as long as wide, with fewer annulations (about 9)."

Length 106 μ; breadth 31–34 μ.

Me.: Scarbro', rare (*W. West*). Type locality.

I have not seen this species although the type locality is in Maine. There are three other stations for this species in the United States but it has not been found in New England since its first discovery. The descriptions are rough translations of the originals. The measurements are those given by West.

Boston Society of Natural History.

ERRATA.

Page 24, line 15; for *atropurpuresa, Juncu* read *atropurpurea, Juncus.*
" 54, " 5; for Razoumowsk a *read* Razoumowskia.
" 55, " 2; " Med k *read* Medik.
" 64, " 1; " use *read* rise.
" 116, " 8; " *microphyllum* read *semiorbiculatum.*
" 122, " 7; " *Amonum* read *Amomum.*
" 124, " 27; " *Cyprepedium* read *Cypripedium.*
" 126, " 1; " *amphirhyncus* read *amphirhynchus.*
" 129, " 9; " *strigilis* read *strigile.*
" 130, " 1; " *Ditylum* read *Ditylium.*
" 132, " 1; after *Navicula* insert *nobilis.*
" 148, " 12; *for* Lauholzkunde *read* Laubholzkunde.
" 164, " 25; *for* Wormskjoldii *read* Wormskioldii.
" 199, " 14; for *Herbipolenis* read *Herbipolensis.*
" 199, " 37; " *Aromachys* read *Aromochelys.*

Vol. 9, no. 107, including pages 209 to 220, was issued 10 December, 1907.

INDEX TO VOLUME 9.

New scientific names are printed in full face type.

Abies balsamea, 158, 169; nigra, 173.
Acanthospermum, 26; australe, 26, at Lawrence, Massachusetts, 26.
Acer coccineum, 116; eriocarpum, 116; glaucum, 116; microphyllum, 116, 117; rubrum, 116, 117, subsp. microphyllum, 116, var. tomentosum, 116, var. tridens, 116, 117; saccharinum, 116; semi-orbiculatum, 116, 117; tomentosum, 116, 117.
Achillea borealis, 164, 191.
Achnanthes brevipes, 136; curvirostrum, 136; longipes, 136; manifera, 136; subsessilis, 136.
Achnanthidium flexellum, 131, 136.
Acosmus, 44.
Acroxis, 18.
Actinella punctata, 138.
Actinocyclus Barkleyi, 129, 139; crassus, 139; Ehrenbergii, 139; Ralfsii, 139; subtilis, 139; tenuissimus, 139; triradiatus, 139.
Actinoptychus, 130; undulatus, 140; velatus, 140.
Adenoscilla, 37.
Adiantum, 27, 82, 174; Capillus-Veneris, 39; pedatum, 82, var. aleuticum, 155, 158, 167, 174.
Adicea, 54.
Adnaria, 54.
Adopogon, 55.
Aecidium, 195.
Agaricus octogesimus nonus, 51.
Ageratum, 50.
Agrostis borealis, 156, 158, 169, 190; diffusa, 20, 21; filiformis, 19; foliosa, 19; frondosa, 19; lateriflora, 18, var. filiformis, 19; mexicana, 18, 19; racemosa, 22; setosa, 22; sobolifera, 18; sylvatica, 18, 20; tenuiflora, 18.
Ailanthus, 54.
Alacospermum, 54.
Alchemilla, 92; alpina, subsp. eualpina, 47; pratensis, 92, found at Westford, Massachusetts, 92.
Alexitoxicon, 40.
Algae, 36, 77, 78; The Basis of Nomenclature for, 77; Causes of Variation in Color of some red, 90; Red, 90; Some new green, 197.
Alicularia, 58; Geoscyphus, 57; minor, 57; Roteana, 58; scalaris, β minor, 57, 58.
Allium tricoccum, 12; vineale, 12.
Alnus, 18; alnobetula, 153; crispa, 153, 156, 160, 190; incana, 48; lanuginosa, 48; mollis, 160.
Alpine Rhinanthus of Quebec and New Hampshire, 23; Variety of Houstonia caerulea, 209.
Amaryllidaceae, 50.
Amelanchier, 179; oligocarpa, 156; rotundifolia, 223; spicata, 223.
America, The Genus Suaeda in northeastern, 140; Salicornia europaea and its Representatives in eastern, 204; Some new Willows of eastern, 221; Variations of Primula farinosa in northeastern, 15.
American Diervillas, Flower Color of the, 147.
Ammophila arenaria × Calamagrostis epigeios, 42; arundinacea, 218; × baltica, 42.
Amphicarpaea, 54; Pitcheri, 12.
Amphiprora, 130; alata, 135; conspicua, 135; lepidoptera, 135, var. pusilla, 135; maxima, 135; ornata, 135; pulchra, 128, 135; vitrea, 135.
Amphiptetras, 130; antediluvianus, 139.
Amphora, 128, 130; cingulata, 135; Clevei, 135; cymbifera, 135; erebi, 135; Eulensteinii 135; intersecta, 135; levis, 135; obtusa, 136; ovalis, 136; proteus, 135.
Amsinckia, 55.
Anaphalis margaritacea, 122.
Anarrhinum, sect. Anarrhinum, 47.
Andromeda glaucophylla, 163, 169, 189; tetragona, 182.
Andropogon macrothrix, 40; ternatus, subsp. macrothrix, 40.
Anemone multifida, 161, 166; parviflora, 161, 166, 183, 190; riparia, 161.
Anemonella, 151; thalictroides, 151.
Angiospermae, 36.

Anidrum, 54.
Ankleberries, 5.
Annual Field Meeting of the Vermont Botanical and Bird Clubs,Thirteenth, 108; Meeting of the Josselyn Botanical Society, Thirteenth, 107.
Antennaria neodioica, var. gaspensis, 164.
Anthoceros, 219.
Anthriscus, sect. Eu-anthriscus, 47.
Apios tuberosa, 13.
Arabis, 40; alpina, 161, 190, 191; Collinsii, 161; Drummondi, 161; hirsuta, 161; spathulata, 40.
Aralia hispida, 122; trifolia, 13.
Arbor Vitae, 163.
Arbutus Uva-ursi, 182.
Arceuthobium, 54, 75, 76, 208, in the Rangeley Region, 28; pusillum, 28, 76, 124, 208, at Mt. Desert, 75.
Archieracium, 37.
Arctostaphylos alpina, 163, 166; Uva-ursi, 163, 181, 182.
Ardissonia superba, 137.
Arenaria, 63; arctica, 155, 161, 167, 174, 186; ciliata, var. humifusa, 161, 167; groenlandica, 156, 161, 166, 177, 179–181; hirta, 154; macrophylla, 63; sajanensis, 161, 167, 186; verna, 154, var. propinqua, 154, 161, 174.
Arisaema triphyllum, 121.
Arnica Chamissonis, 154; chionopappa, 164; gaspensis, 164; mollis, 154, 164, 191.
Aromochelys, 199, 234; odorata, 199.
Artemisia borealis, 155, 164, 167, 174, 186, var. Wormskioldii, 164, 167, 174; canadensis, 154, 164, 167.
Arthur, J. C., Peridermium pyriforme and its probable alternate Host, 194.
Arundinella, 50.
Arundinelleae, 50.
Asclepiadaceae, 52.
Asclepiadeae, 37.
Asclepias 37; obtusifolia, 14; pulchra, 122.
Asphodeloideae, 37.
Asphodelus, 37.
Aspicarpa, 44.
Aspidium, 83; acrostichoides, 83; Boottii, 83; cristatum, 83, var. Clintonianum, 83, 124, × marginale, 84; fragrans, 154, 158; marginale, 83, var. elegans, 83; noveboracense, 83; simulatum, 74, 83; spinulosum, 84, 208, var. concordianum, 84; var. dilatatum, 84, forma **anadenium** 84, 218, var. intermedium, 84; Thelypteris, 83, forma Pufferae, 83.
Asplenium, 82; acrostichoides, 12, 83; Adiantum nigrum, 175, subsp. serpentini, 175; adulterinum, 175; **cyclosorum**, 155, 158; ebeneum, 82; Filix-foemina, 27, 83, var. angustum, 83; platyneuron, 82, var. serratum, 82; thelypteroides, 83; Trichomanes, 82; viride 154, 158, 166, 172, 175.
Aster, 151, 157; foliaceus, 164, 191; novibelgii, 39; puniceus, var. oligocephalus, 164; subulatus, 151.
Asterionella formosa, 137; Ralfsii, 137.
Asterostemma, 52.
Astragalus, 154; alpinus, 162; Blakei, 154, 155, 162, 167; cariensis, 50; contortuplicatus, 38; elegans, 162, 167, 172; frigidus, var. americanus, 162; Jesupi, 154; rhizanthus, 50.
Astrostemma, 52.
Athyrium cyclosorum, 158.
Atriplex maritima, 144.
Auliscus caelatus, 139; Macraëanus, 139; pruinosus, 139; sculptus, 139.

Bacillaria paradoxa, 131, 136.
Baeothryon, 51.
Baked-apple, 150.
Balsam, Fir, 76.
Baptisia tinctoria, 121.
Bartlett, H. H., Flower Color of the American Diervillas, 147; The retrograde Color Varieties of Gratiola aurea, 122.
Bartonia virginica, 122.
Bartramia, 37.
Basilima, 54.
Basis of Nomenclature for Algae, 77.
Behen, 55.
Belamcanda, 53.
Benthamia, 55.
Berteroa, incana, 227.
Betula alba, var. minor, 156, 160, var. urticifolia, 111; glandulosa, 160, 169, 174, 190; incana, 48; lenta, forma **laciniata,** 111; pendula, forma dalecarlica, 111; pumila, 189.
Bibracteolata, 37.
Biddulphia aurita, 138; Baileyi, 138; levis, 130, 139; pulchella, 138; rhombus, 138; Tuomeyi, 138.
Bidens Beckii, 63; comosa, 14; laevis, 120.
Biforia, 54.
Bikukulla, 54.

Black Oak, 61; Raspberry, 4; Spruce, 28, 208.
Blackberry, Hog, 5.
Blanchard, W. H., Connecticut Rubi, 4.
Blephariglottis grandiflora, 154.
Blessed Thistle, 28.
Blue Fringed Gentian, 28.
Bluet, 210.
Boehmeria cylindrica, 121.
Boletus vicesimus sextus, 51.
Boston District, Reports on the Flora of the,— I, 81.
Botanical and Bird Clubs, Thirteenth annual Field Meeting of the Vermont, 108; Society of Maine, Bulletin of the Josselyn, 196; Society of Maine, Meeting of the Josselyn, 107, 124.
Botrychium, 85; lanceolatum, var. angustisegmentum, 85; matricariaefolium, 85; obliquum, 86, var. dissectum, 86, var. elongatum, 86; ramosum, 85; simplex, 85; ternatum, var. intermedium, 86; virginianum, 86.
Bouchea, 38.
Brainerd, E., Mendel's Law of Dominance in the Hybrids of Viola, 211; The older Types of North American Violets,— I, 93.
Brassica Napus, 39.
Braya humilis, 161.
Brebissonia Boeckii, 135.
Bromeliaceae, 37.
Bromeliineae, 37.
Brooms, Witches', 75.
Broussonetia tinctoria, 91.
Brunella vulgaris, 122.
Buda, 54.
Bulletin of the Josselyn Botanical Society of Maine, 196.
Bureaua, 38.
Bursa, 54.

Calamagrostis, 157; purpurascens, 158; cinnoides, 121; hyperborea, 158; Langsdorfii, 158, 166; Pickeringii, 156, 158.
Callithamnion, 91.
Calluna, 47.
Calochortus albus, 51; Nuttallii, 51.
Calocylindrus curtus, 232; minutus, 233.
Caloneis Wardii, 131, 134.
Calopogon, 53.
Calypogeia, 56; arguta, 67, 69; bifurca, 67; fissa, 70; sphagnicola, 65, 66, 70, 71; suecica, 66, 70, 71; Sullivantii, 67–69, 73; **tenuis**, 69–71, 73; Trichomanis, 65–67, 69–71, var. tenuis, 69.
Calystegia, 46, 55.
Campanopsis, 48.
Campanula, 157; aparinoides, 122; sect. Campanopsis, 48; uniflora, 163.
Camptosorus, 83, 187; rhizophyllus, 83, 187.
Campulosus, 53.
Campylodiscus echineis, 128, 137; hibernicus, 137.
Capellia, 47.
Capnoides, 54.
Capnorchis, 54.
Capparis lasiantha, 45.
Capriola, 53.
Capsella, 54.
Carbenia, 55.
Cardamine, 47; bellidifolia, var. laxa, 161; glacialis, 48, var. subcarnosa, 48; hirsuta, var. subcarnosa, 48; propinqua, 48.
Carduus, 48, 55; sect. Alfredia, 48.
Carelia, 50, 55.
Carex, 40, 120; alpina, 159; atrata, var. ovata, 159, 190; Backii, 159, 208, bicolor, 159; brunnescens, 63, 156, 159, 169; canescens, 159, 169, var. subloliacea, 159; capillaris, 159, var. elongata, 159, 190; capitata, 155, 159; concinna, 159; deflexa, 159, 190; durifolia, 208; eburnea, 63, 159, 166, 172, 187; Grahami, 155, 160; Halleriana, 39; hypnoides, 166; katahdinensis, 155; lagopina, 159, 167; lenticularis, 159; limosa, 159, 189; Michauxiana, 156, 160; obtusata, 159; oligosperma, 160; pauciflora, 160, 189, 207; paupercula, 159, var. irrigua, 159, 189; rariflora, 159, 166, 180, 181; rigida, 159, var. Bigelowii, 156, 159, 169; saxatilis, 155, 160, var. miliaris, 160, 166; scripoidea, 159, 169; stellutata, 159, 190; vaginata, 159, 189.
Carica, 40.
Carpenter, D. S., Thirteenth Annual Field Meeting of the Vermont Botanical and Bird Clubs, 108.
Carphalea, 43.
Carya, 53.
Caryophyllaceae, 37.
Cassiope hypnoides, 163; tetragona, 182.
Castilleja acuminata, 154; pallida, var. septentrionalis, 24, 154, 163, 169, 190.

Cat Spruce, 76.
Catharinaea, 99; angustata, 64, 99; crispa, 74, in Maine, An Occurrence of, 74; Macmillani, 98, 99.
Cathea, 53.
Causes of Variation in Color of some red Algae, 90.
Celtis occidentalis, 12.
Centaurea Jacea, 46; vulgaris, 46.
Centrospermae, 37.
Cephalanthus occidentalis, 122.
Cephalozia lunulaefolia, 66.
Cerastium arvense, 161, 174, 175, var. oblongifolium, 175; beeringianum, 161; cerastioides, 155, 161.
Cerataulus levis, 139; polymorphus, 139.
Chaetomorpha, 199, 200; aerea, 199; **Chelonum**, 198; Henningsii, 199; Herbipolensis, 199.
Chamaecistus, 54.
Chamaecyparis on Long Island, New York, New Station for, 74; thyoides, 74.
Chamaedaphne calyculata, 163, 189.
Chamaenerium angustifolium, 121.
Chamberlain, E. B., Catharinaea Macmillani, 98; Meeting of the Josselyn Botanical Society, 124; Thirteenth Annual Meeting of the Josselyn Botanical Society, 107.
Cheiranthus tristis, 45.
Chenopodiaceae, 143.
Chenopodina linearis, 146; maritima, 145, 146, var. vulgaris, 142, 145.
Chenopodium maritimum, 142–146.
Chesterville, Maine, Notes on Plants of, 207.
Chimaphila maculata, 122; umbellata, 122.
Chiogenes serpyllifolia, 14.
Chlorophyceae, 78.
Chrysemys, 199; marginata, 199.
Chrysopsis, 55; falcata, 122.
Cicuta bulbifera, 122; maculata, 122.
Cincinnulus suecicus, 66; Trichomanis, var. sphagnicola, 65, var. suecicus, 66.
Circaea lutetiana, 39.
Cirsium, 55; muticum, var. **monticola**, 28, 164, 167, 191, Note on 28; supercanum × rivulare, 42.
Cisticapnos, 54.
Cladophora **amphibia**, 200; expansa, 197.
Claytonia virginica, 75.
Clematis, 151; verticillaris, 63; virginiana, 151.
Clethra, 196; alnifolia, 122, 196, A pink-petaled Form of, 195.
Closterium curtum, 232; Libellula, 228; margaritaceum 229; polymorphum, 231; Trabecula, 103; truncatum, 103; verrucosum, 105.
Clubs, Thirteenth Annual Field Meeting of the Vermont Botanical and Bird, 108.
Cnicus, 28, 55; benedictus, 28, 55; muticus, var. monticola, 28.
Cocconeis dirupta, 136; scutellatum, 136.
Colinil, 54.
Collaea, 38.
Collins, F. S., The Basis of Nomenclature for Algae, 77; Is Rhinanthus Crista-galli an introduced Plant? 26; Some new green Algae, 197.
Color of the American Diervillas, Flower, 147.
Comandra livida, 154, 156, 160, 189, 190, 219.
Compositae, 26, 37.
Comptonia, 194, 195; peregrina, 194.
Congress, On the Rules of Botanical Nomenclature adopted by the Vienna, 29.
Coniferae, 36.
Conioselinum Gmelini, 224.
Connecticut Diatoms with some Account of their Distribution in certain Parts of the State, A partial List of, 125; Noteworthy Plants of Salisbury, 74; Plants, Notes on, 10; Rubi, 4.
Contortae, 37.
Convolvulus, 37, 46, 47; spithamaeus, 124.
Coptis trifolia, 121.
Cornus Amomum, 122; canadensis, 63.
Corydalis, 54.
Corylus americana, 124.
Coscinodiscus, 130; apiculatus, 139; asteromphalus, 139; concinnus, 139; excentricus, 139; gigas, 139; marginatus, 139; nitidus, 139; oculus-iridis, 139; radiatus, 139; subtilis, 139; symbolophorus, 139.
Cosmarium cruciferum, 232; curtum, 232.
Cracca, 54.
Crockett, A. L., An Occurrence of Catharinaea crispa in Maine, 74.
Cronartium, 194; Comptoniae, 194; Quercus, 194.
Crow-berry, 149, 177.
Cruciferae, 37.

Crucifers, 40.
Cryptogramma densa, 158, 167; Stelleri, 154, 158, 166, 172, 173.
Cryptotaenia, 54.
Ctenium, 53.
Cuphea, 63; viscosissima, 63.
Curlew-berry, 149, 177.
Currant, Red, 1.
Cuscuta, 50; compacta, 11.
Cushman, J. A., New England Species of Penium, 227; Primula farinosa, var. macropoda on the Maine Coast, 217; Synopsis of the New England species of Pleurotaenium, 101.
Cyclotella antiqua, 125, 140; Kuetzingiana, 140; striata, 140.
Cymatopleura elliptica, 137; hibernica, 137; marina, 137; solea, 137.
Cymbella, 131; affinis, 135; americana, 135; cistula, var. maculata, 135; cuspidata, 135; cymbiformis, var. parva, 135; Ehrenbergii, 135; gastroides, 135; heteropleura, 135.
Cynanchum nivale, 43.
Cynodon, 53.
Cypripedium acaule, 121; Hookerae, 39; parviflorum, 160; spectabile, 124.
Cystopteris, 84; bulbifera, 124; fragilis, 84, 158; montana, 158, 170.
Cytisus, 51; biflorus, 51; Fontanesii, 51.

Dactilon, 53.
Dactylicapnos, 54.
Danthonia intermedia, 28, 159, 167, 190.
Dasya, 91; elegans, 90.
Datisca hirta, 115.
Dentaria, 47.
Denticella mobiliensis, 138; rhombus, 138.
Deringa, 54.
Deschampsia atropurpurea, 24, 156, 158, 166, 190; caespitosa, var. alpina, 158, 167, 191.
Desmids, 227.
Desmodium, 54; canadense, 121; ciliare, 121; cuspidatum, 13; paniculatum, 121; rigidum, 121; sessilifolium, 13.
Diandrae, 221.
Dianthus Caryophyllus, 37; monspessulanus, 39.
Diapensia, 154; lapponica, 163, 169.
Diatoma anceps, 137; elongatum, var. tenue, 137; hiemale, 137; tenue, 137; vulgare, 137.
Diatoms, 125–129, with some Account of their Distribution in certain Parts of the State, A partial List of Connecticut, 125.
Dicentra, 54.
Dickiea crucigera, 135.
Dicksonia, 27, 85; pilosiuscula, 85; punctilobula, 85.
Diclytra, 54.
Dicotyledoneae, 36.
Dicranum Bergeri, 65.
Dielytra, 54.
Diervilla, 147; Lonicera, 147; rivularis, 147; sessilifolia, 147; splendens, 147; trifida, 147.
Diervilla § Weigela, 147.
Diervillas, Flower Color of the American, 147.
Digitalis lutea × purpurea, 41.
Dimerogramma minus, 138; Surirella, 138.
Diphryllum, 53.
Diplogon, 55.
Diplomorpha, 49.
Diploneis didyma, var. obliqua, 134.
Dissarrenum, 53.
Ditylium Brightwellii, 130, 139; inaequale, 139; intricatum, 139; tetragonum, 139; trigonum, 139.
Dobbin, F., Rediscovery of Podostemon ceratophyllus in Vermont, 220.
Docidium Archeri, 104; clavatum, 104; constrictum, 105; coronatum, 102; Ehrenbergii, 103; indicum, 104; maximum, 104; minutum, 232; nodosum, 105; nodulosum, 102; Trabecula, 103; truncatum, 103; verrucosum, 105.
Dondia, 54, 140; americana, 141, 144, 146; maritima, 141, 145.
Draba arabisans, 161, var. orthocarpa, 161; aurea, 161; corymbosa, 161; incana, 154, 161, var. confusa, 161; megasperma, 161; pycnosperma, 161; stylaris, 154, 161, 166.
Drosera intermedia, 121; linearis, 189; rotundifolia, 121.
Droseras, 120.
Dryas Drummondii, 151, 152, 162, 167, 179, 188, 191; integrifolia, 162, 167, 183.
Dryopteris, 27; acrostichoides, 27; Filix-mas, 27, in Vermont, Further information regarding the Occurrence of, 27; fragrans, 154; Goldiana, 27; marginalis, 27; noveboracensis, 27, 121; simulata, 121; spinulosa, 27, 121; Thelypteris, 121.

Dulichium arundinaceum, 121.
Dunham, E. M., Polytrichum gracile Dicks. in Maine, 64.
Durvillea, 38, 52.
Dwarf Mistletoe, 75, on the southeastern Coast of Maine, 208.

Eames, A. J., Preliminary Lists of New England Plants,— XX, Sparganiaceae, 86.
Eames, E. H., A new Variety of Scirpus Olneyi, 220.
Eaton, L. O., Notes on Plants of Chesterville, Maine, 207.
Eatonia, 11; Dudleyi, 11.
Echinocystis, 55.
Echinospermum Lappula, 14.
Egeria, 44.
Elaeagnus argentea, 162, 179.
Eleocharis olivacea, 74.
Ellisia, 55.
Elymus mollis, 218.
Embelia Sarasinorum, 39.
Empetrum, 178, 193; nigrum, 149–152, 156, 162, 169, 170, 174, 177, 178, 180–182, 189, 218, var. andinum, 162, 219.
Enantioblastae, 37.
Encyonema caespitosum, 135; prostratum, 135.
Englera, 38.
Englerastrum, 38.
Englerella, 38.
Epilobium, 157; alpinum, 154, 162, 191; anagallidifolium, 162; strictum, 63.
Epiphegus, 55.
Epithemia argus, 138; gibba, 138, var. ventricosa, 138; musculus, 138; turgida, 138; zebra, 138.
Eragrostis minor, 12.
Erica, 47; vulgaris, 47.
Erigeron acris, 164, 189, var. debilis, 164, var. droebachensis, 164; hyssopifolius, 154, 164, 167, 172, 191.
Eriocaulon septangulare, 121.
Eriphorum callitrix, 159, 180, 181, 189, 218; Chamissonis, 159, 224, var. albidum, 159; virginicum, 121.
Erodium cicutarium, 124.
Erophila, 54.
Erysimum hieraciifolium, subsp. pannonicum, var. longisiliquum, 41, subsp. strictum, var. longisiliquum, 41.
Erythrina, 43; micropterix, 43; Poeppigiana, 43.
Euastrum oblongum, 79.
Euhelianthemum, 46.
Euhermannia, 37.
Eunotia Diadema, 138; elongata, 138; flexuosa, 138; gracilis, 138; lunaris, 138; major, 138; praerupta, 138, var. bidens 138; robusta, 138.
Eunotogramma laeve, 138.
Eupatorium, 49.
Euphorbia maculata, 121.
Euphrasia borealis, 163; latifolia, 163, 190; Oakesii, 163; Williamsii, 155, 163.
Eupodiscus, 130; argus, 139; Rodgersii, 139.
Eusideroxylon, 38.
Evans, A. W., Notes on New England Hepaticae,— V, 56, 65.

Fagopyrum, 54.
Fagus alba, 114; americana, 112–114, var. latifolia, 113; atropunicea, 112, 113; grandifolia, 112, 113, var. **caroliniana**, 114, forma **mollis**, 114, 115; grandifolia, forma **pubescens**, 111, 114, 115; ferruginea, 112–115, var. caroliniana, 113, 114, var. latifolia, 113, 114; heterophylla, 114; latifolia, 112, 113; nigra, 114; rotundifolia, 114; sylvatica, 113, 114, var. americana, 113, var. americana latifolia, 113, var. atropunicea, 113; sylvestris, 113, 114.
Falcata, 54.
Fedia, 55.
Fern, Holly, 27.
Fernald, M. L., The alpine Rhinanthus of Quebec and New Hampshire, 23; The Genus Suaeda in northeastern America, 140; Note on Cirsium muticum, var. monticola, 28; Preliminary Lists of New England Plants,— XX, Sparganiaceae, 86; Ribes vulgare and its indigenous Representatives in North America, 1; Salicornia europaea and its Representatives in eastern America, 204; The Soil Preference of certain alpine and subalpine Plants, 149; Some new Willows of eastern America, 221; Streptopus oreopolus a possible Hybrid, 106; The Variations of Primula farinosa in northeastern America, 15.
Festuca, 174; altaica, 155, 159, 167, 174, 188, 224; ovina, var. brevifolia, 159; rubra, var. prolifera, 159.
Fibichia, 53.
Ficus indica, 39.
Fimbriati, 37.

Fimbristylis, 53; capillaris, 121.
Fir Balsam, 76.
Fletcher, E. F., Alchemilla pratensis, found at Westford, Massachusetts, 92.
Flora of the Boston District, Reports on the,—I, 81; of the Great Swamp of Rhode Island, 117.
Flower Color of the American Diervillas, 147.
Flowering Raspberry, 5.
Forbes, F. F., Reports on the Flora of the Boston District,— I, 81.
Form of Clethra alnifolia, A pink-petaled, 195.
Fragillaria capucina, 137; construens, 137; Harrisonii, 131, 137; virescens 137.
Fraxinaster, 37.
Fringed Gentian, Blue, 28.
Fritillaria alba, 51.
Frullania, 72; Asagrayana, 72, 73; Brittoniae 73; Tamarisci, 72, 73.
Frustulia Lewisiana, 135; rhomboides, 135, var. saxonica, 135; viridula, 135.
Fucus, 78.
Fumana, 46.
Fumaria Gussonei, 39.
Fungi, 36.
Furera, 55.
Further Information regarding the Occurrence of Dryopteris Filix-mas in Vermont, 27.

Galium asprellum, 122; boreale, 14; kamtschaticum, 163.
Galionella nummuloides, 140.
Gansblum, 54.
Gaylussacia, 54; dumosa, 119.
Gemmingia, 53.
Genista Boissieri, 47; horrida, 47; Webbei, 47.
Gentian, Blue Fringed, 28.
Gentiana acuta, 154; Amarella, var. acuta, 154, 163, 167.
Genus Suaeda in northeastern America, 140.
Geocalyx graveolens, 73.
Geranium Robertianum, 39.
Gerardia, 38; paupercula, 122; purpurea, 122.
Gesnera Donklarii, 45.
Geum Peckii, 154, 155, 162; radiatum, 154.
Glaziоua, 38.
Globularia cordifolia, 45.
Gloriosa, 37.
Glumiflorae, 37.
Glyceria, 53; canadensis, 121; nervata, var. stricta, 208; obtusa, 121.
Gnaphalium norvegicum, 24, 164, 191; supinum, 154, 164; uliginosum, 154.
Gomphonema acuminatum, 136; augur, 136; capitatum, 136; constrictum, 136; cristatum, 136; geminatum, 136.
Goodyera pubescens, 121.
Graderia, 38.
Gramineae, 37, 50.
Grammatophora oceanica, var. macilenta, 138.
Gratiola at Westfield, a clerical Error, Record of Color Varieties of, 195; aurea, 122, 123, 195, forma **helveola**, 123, forma **leucantha**, 123, The retrograde Color Varieties of, 122; Drummondii 123; ebracteata, 123; floribunda, 123; gracilis, 123; macrantha, 123; pusilla, 123; ramosa, 123; sphaerocarpa, 123; Torreyi, 123; virginiana, 123; viscosa, 123.
Gratiolaria, 123.
Grimmaldia fragrans, 73.
Guttiferae, 37.
Gymnocimum, 37.
Gymnospermae, 36.
Gypsophila, 48, sect. Vaccaria, 48.
Gyrosigma Temperii, 135.
Gyrostachis, 53.
Gyrotheca, 53.

Habenaria blephariglottis, 119, 121, 124; ciliaris, 119; clavellata, 121; dilatata, 160, 189, 190; fimbriata, 154; hyperborea, 124; macrophylla, 124; orbiculata, 74; psycodes, 121.
Halenia, 55.
Handy, L. H., A pink-petaled form of Clethra alnifolia, 195.
Hantzschia amphioxys. 136; segmentalis, 136.
Haplopappus, 55.
Harger, E. B., An interesting Locality, 62.
Harrison, A. K., Reports on the Flora of the Boston District,— I, 81.
Hedypnois, 55.
Hedysarum, 37, 154, 193; americanum, 154; boreale. 154, 162, 167, 172, 179; Mackenzii, 179.
Helianthemum, 46; italicum, var. micranthum, 48; penicillatum, 48, var. micranthum, 48.
Helxine, 54.

Hemiaulus affinis, 138; tubulosus, 138.
Hemigenia, sect. Hemigenia, 47.
Hepaticae, 63, Notes on New England, — V, 56, 65.
Heritieria, 53.
Herniaria diandra, 40; hirsuta, var. diandra, 40.
Heteranthera, 53; graminea, 63.
Heterodraba, 37.
Hicoria, 53.
Hicorius, 53.
Hieracium Flahaultianum, 43; floribundum, 63; Gronovii, 122; scabrum, 122.
Hierochloe, 53; alpina, 156, 158, 166; borealis, 11.
Hog Blackberry, 5.
Holly Fern, 27.
Homalocenchrus, 53.
Hoorebeckia, 55.
Host, Peridermium pyriforme and its probable alternate, 194.
Hottonia inflata, 14, 63.
Houstonia caerulea, 209, 210, Alpine Variety of, 209, forma albiflora, 210, var. **Faxonorum**, 210; serpyllifolia, 210.
Hyalodiscus stelliger, 140; subtilis, 140.
Hybrid, Streptopus oreopolus a possible, 106.
Hybrids of Viola, Mendel's Law of Dominance, in the 211.
Hydrocotyle umbellata, 13.
Hydrophyllum virginicum, 75.
Hypericum boreale, 121; canadense, 121; gentianoides, 121; maculatum, 121; virginicum, 121.
Hypoxis erecta, 121.

Ibidium, 53.
Ilex, 151; monticola, 151; opaca, 13.
Ilicioides, 54.
Ilysanthes attenuata, 122; gratioloides, 122.
Impatiens, 37.
Interesting Locality, 62.
International Rules for Botanical Nomenclature chiefly of Vascular Plants, 33.
Ioxylon pomiferum, 91.
Iria, 52, 53.
Iriha, 53.
Iris, 52; setosa, 219; versicolor, 219.
Isthmia nervosa, 131, 138.

Josselyn Botanical Society, Bulletin of the, 196, Meeting of the, 107, 124.
Joxylon, 54.
Juncoides, 3.
Juncus alpinus, 160; brevicaudatus, 121; canadensis, 121; castaneus, 24, 160, 190; filiformis, 156, 160, 189; marginatus, 121; militaris, 119; pelocarpus, 121; tenuis, var. Williamsii 121; trifidus, 156, 160, 169.
Juniperus communis, var. montana, 158; horizontalis, 202, forma **lobata**, 202.
Jungermannia dovrensis, 58; haematosticta, 57, 58; longidens, 59; porphyroleuca, var. attenuata, 59; scalaris, β minor, 57, β repanda, 57; Silvrettae, 57.

Kalmia, 187; angustifolia, 163, 169, 189; glauca, 182; latifolia, 122, 187; polifolia, 163, 169, 182, 189.
Kantia, 56; sphagnicola, 65; suecica, 66; Sullivantii, 67, 73; Trichomanis, 66, var. tenuis, 69.
Kernera, 38.
Kneiffia pumila, 122.
Knight, O. W., Three Plants from Maine, 202.
Knowlton, C. H., Newly observed Stations for Massachusetts Plants, 11; Noteworthy Plants collected at Roque Bluffs, Maine, in 1907, 218; Reports on the Flora of the Boston District,— I, 81.
Koellia, 55; virginiana, 122.
Krigia, 55.

Labiatae, 37, 50.
Lachnanthes, 53; capitata, 119.
Laciniaria, 55.
Lamson-Scribner, see Scribner, F. Lamson.
Lapeyrousea, 38.
Laplacea, 49.
Laportea, 54.
Lappula deflexa, 163.
Larix laricina, 158, 169.
Lauraceae, 38.
Lawrence, Massachusetts, Acanthospermum australe at, 26.
Ledum groenlandicum, 156, 162, 169, 170, 174, 189; palustre, 182.
Leersia 53.
Leguminosae, 37.
Lemairea, 50.
Leontodon autumnale, 122.
Lepargyrea, 54.
Lepidium spathulatum, 40.
Leptamnium, 55.
Leptorkis, 53.
Leptostachys, 51.

Leptothrix, 131.
Lerchea, 54.
Lespedeza capitata, 121; frutescens, 120, 121.
Leucothoe racemosa, 14.
Liatris, 55.
Libellus rhombicus, 134.
Lichenes, 36.
Licmophora flabellata, 138; Juergensii, 138; tincta, 138.
Lignum, 51.
Linaria genistaefolia, 14; Linaria, 51.
Linum usitatissimum, 119.
Liparis, 53.
Liquidambar, 37.
List of Connecticut Diatoms with some Account of their Distribution in certain Parts of the State, 125.
Listera, 53.
Lists of New England Plants, Preliminary,— XX, Sparganiaceae, 86.
Lithodesmium undulatum, 139.
Lobelia cardinalis, 120, 122; Dortmanna, 119; inflata, 122; Kalmii, 164, 189, 190.
Loiseleuria, 54; procumbens, 154, 162, 169, 177.
Long Island, New York, New Stations for Chamaecyparis on, 74.
Lonicera caerulea, var. villosa, 163, 190; oblongifolia, 189.
Lophozia, 56; alpestris, 59; confertifolia, 59; excisa, 73; longidens, 59, 60; porphyroleuca, 66, 73; ventricosa, 59; Wenzelii, 59.
Lotus siliquosus, 48.
Lupinus perennis, 124.
Luzula, 53; confusa, 160; parviflora, 156, 160, 169; spicata, 160, var. tenella, 160, 167.
Lychnis alba, 121; alpina, 160, 167, 174, 186, 191.
Lycopodium alpinum, 158; annotinum, 63, 74, var. pungens, 158; complanatum, 121; lucidulum, 121; obscurum, 121; Selago, var. appressum, 156, 158, 169, var. patens, 158; sitchense, 158.
Lycopus americanus, 122; virginicus, 120, 122.
Lygodium, 85; palmatum, 85.
Lyngbya aestuarii, 197.
Lysias, 53.
Lysigonium moniliforme, 139; varians, 139.
Lysimachia Hemsleyana, 39; Hemsleyi, 39; producta, 14; quadrifolia, 122; thrysiflora, 207.
Lythrum alatum, 75; Hyssopifolia, 39; intermedium, 48; Salicaria, 49, var. gracilius, 49; var. intermedium, 49.

Maclura, 54, 91; aurantiaca, 91; **pomifera,** 91, 148.
Macrocalyx, 55.
Madia, 37.
Madiinae, 37.
Magnolia foetida, 48; grandiflora, 48; virginiana, var. foetida, 48.
Magnusia, 38.
Maine, Bulletin of the Josselyn Botanical Society of, 196; Coast, Primula farinosa, var. macropoda on the, 217; The dwarf Mistletoe on the southeastern Coast of, 208; in 1907, Noteworthy Plants collected at Roque Bluffs, 218; Notes on Plants of Chesterville, 207; An Occurrence of Catharinaea crispa in, 74; Polytrichum gracile Dicks. in, 64; Three Plants from, 202.
Majanthemum, 53.
Malva Tournefortiana, 39.
Malvaceae, 37.
Malvineae, 37.
Manihot, 37.
Mariana, 55.
Marsupella, 57; erythrorhiza, 57; media, 57; Silvrettae, 57; **Sullivantii,** 57.
Marsypocarpus, 54.
Martia, 38.
Martinella apiculata, 71.
Martuisia, 38.
Massachusetts, Acanthospermum australe at Lawrence, 26; Alchemilla pratensis found at Westford, 92; Notothylas orbicularis in, 219; Plants, Newly observed Stations for, 11.
Mastogloia gibbosa, 135; undulata, 135.
Matricaria discoidea, 14.
Matthiola, 45; tristis, 45.
Medeola virginiana, 121.
Medicago denticulata, 124; orbicularis, 45; polymorpha, var. orbicularis, 45; sativa, 121.
Meeting of the Josselyn Botanical Society, 107, 124; of the Vermont Botanical and Bird Clubs, 108.
Meibomia, 54.
Melinis, 50.
Melosira Borreri, 128, 139; coronata, 140; nummuloides, 140; octogona, 140; sculpta, 140; undulata, 140; varians, 139.

Mendel's Law of Dominance in the Hybrids of Viola, 211.
Mentha, 49; arvensis, 122; bracteolata, 44; foliicoma, 44; longifolia × rotundifolia, 42; spicata, 48, var. viridis, 48; villosa, β Lamarckii, 42; viridis, 48.
Menyanthes trifoliata, 157, 163, 189, 190.
Meridion circulare, 137; intermedium, 137.
Mertensia, 55.
Mesophylla minor, 58.
Metastelma, 37.
Metastelmatinae, 37.
Metzgeria, 68.
Micrampelis, 55.
Micromelilotus, 37.
Micropterix Poeppigiana, 43.
Microspermae, 37.
Microspora, 78.
Microstylis monophyllos, 160.
Mikania, 55.
Minthe, 49.
Mistletoe, Dwarf, 75; on the southeastern Coast of Maine, The dwarf, 208.
Mitrophora, 55.
Monochaete, 52.
Monochaetum, 52.
Monocotyledoneae, 36.
Montia fontana, 219.
Moore, A. H., Alpine Variety of Houstonia caerulea, 209.
Mormon Weed, 26.
Mosses, 98.
Mount Desert, Arceuthobium pusillum at, 75.
Muhlenbergia, 17, 23; ambigua, 20; diffusa, 17; foliosa, 19–21, subsp. **ambigua,** 20, 21, subsp. **setiglumis,** 20; **glabrifloris,** 22; glomerata, 22, var. ramosa, 22; gracilis, 20; mexicana, 18, 19, 21, 23, subsp. **commutata,** 18, 21, var. filiformis, 19; Notes on, 17; palustris, 17; polystachya, 18; racemosa, 20, 22, var. ramosa, 22, subsp. **violacea,** 22; Schreberi, 17, 22, subsp. **curtisetosa,** 17, subsp. **palustris,** 17; sobolifera, 17, 18, 22, subsp. **setigera,** 18; sylvatica, 18, 20, 21, 23, var. gracilis, 20, var. setiglumis, 20; tenuiflora, 18, 21, 22, subsp. **variabilis,** 18; **umbrosa,** 20–22, subsp. **attenuata,** 21; Willdenowii, 18.
Mulberry, 5.
Murdoch, J. Jr., Arceuthobium in the Rangeley Region, 28.
Myogalum Boucheanum, 43.
Myosotis, 45, 46.
Myrica, 50; asplenifolia, 121; cerifera, 194.

Nabalus Boottii, 154.
Nardia Geoscyphus, 57, 58; haematosticta, 57, 58; insecta, 58, 59; minor, 58; repanda, 57; scalaris, 58; Silvrettae, 58.
Nasturtium sylvestre, 12.
Navicula, 131; advena, 132; americana, 133; amphigomphus, 133; amphipleuroides, 133; amphirhynchus, 126, 133; approximata, 132; arabica, 133; aspera, 133; bacillum, 133; Bartleyana, 133; Boeckii, 135; bombus, 132; borealis, 132; brasiliensis, 132; Brebissonii, 132; californica, var. campeachiana, 133; cancellata, 132; cardinalis, 132; carribaea, 132; circumsecta, 133; clavata, 132; columnaris, 133; crabro, 132; crassinervia, 135; crucicola, 133; cuspidata, 133; dactylus, 132; delawarensis, 133; didyma, 132; digitoradiata, 132; dilatata, 133; diploneis, var. obliquus, 133; directa, 132; distans, 132; divergens, 132; elegans, 133; elliptica, 126, 132, var. oblongella, 132; esox, 133; firma, 133; Fischeri, 133; forcipata, 132; formosa, 133; fortis, 132; fusca, 132; gibba, 132; gigas, 132; Hennedyi, 132; hibernica, 132; Hitchcockii, 133; humerosa, 133; interposita, 133; interrupta, 132; iridis, 133, var. amphigomphus, 133, var. amphirhynchus, 133, var. producta, 133; irrorata, 132; kamorthensis, 133; lata, 128, 132; latissima, 133; Legumen, 132; Lewisiana, 130, 135; liber, 133; limosa, 133; longa, 132; lyra, 130, 132; maculata, 129, 133; major, 132; marina, 133; nobilis, 131, var. dactylus, 132; oblongella, 132; palpebralis, 133; parallela, 133; peregrina, 132; peripunctata, 131, 133; permagna, 129, 130, 133; polyonca, 132; polysticta, 132; Powellii, 133; praetexta, 132; producta, 133; pusilla, 133; pygmaea, 132; rhombica, 134; rhomboides, 135; rhyncocephala, 132; Semen, 128, 132; serians, 133; Sillimanorum, 133;

Smithii, 132; sphaerophora, 133; Tabellaria, 132; theta, 134; trinodis, 134; tubulosa, 134; tumescens, 133; tuscula, 133; viridis, 132; yarrensis, 132; zostereti, 132.
Nazia, 53.
Neckeria, 54.
Needhamia, 54.
Nemopanthus, 54.
Neoplantago, 37.
Nepeta Sieheana, 43.
Nephrodium spinulosum, var. fructuosum, 84; Thelypteris, forma Pufferae, 83.
Neves-Armondia, 51.
New England Hepaticae, Notes on,— V, 56, 65; Plants, Preliminary Lists of,— XX, Sparganiaceae, 86; Species of Penium, 227; Species of Pleurotaenium, Synopsis of the, 101; Trees, Some new or little known Forms of, 109.
New Hampshire, The alpine Rhinanthus of Quebec and, 23.
New York, New Stations for Chamaecyparis on Long Island, 74.
Newly observed Stations for Massachusetts Plants, 11.
Nicandra, 55.
Nichols, J. T., New Stations for Chamaecyparis on Long Island, New York, 74.
Nigritella, 48; angustifolia, 48; nigra, 48.
Nitzschia, 131; acuminata, 136; angularis, 136; circumsuta, 136; Closterium, 136; curvirostris, var. Closterium, 136; curvula, 131, 136; fasciculata, 136; granulata, 136; linearis, var. tenuis, 136; Lorenziana, 136; marginulata, 136; obtusa, 136; plana, 136; scalaris 130, 136; Shafferi, 131, 136; sigma, 136; sigmoidea, 136; tenuis, 136; tryblionella, 136, var. maxima, 136.
Nomenclature adopted by the Vienna Congress, On the Rules of Botanical, 29; chiefly of Vascular Plants, International Rules for botanical, 33; for Algae, The Basis of, 77.
North America, Ribes vulgare and its indigenous Representatives in eastern, 1.
North American Violets, The older Types of,— I, 93.
Norton, A. H., The dwarf Mistletoe on the southeastern Coast of Maine, 208.
Note on Cirsium muticum, var. monticola, 28.
Notes on Connecticut Plants, 10; on Muhlenbergia, 17; on New England Hepaticae,— V, 56, 65; on Plants of Chesterville, Maine, 207.
Noteworthy Plants collected at Roque Bluffs, Maine, in 1907, 218; Plants of Salisbury, Connecticut, 74.
Notothylas, 219; orbicularis, 219, in Massachusetts, 219.
Nuphar advena, 121.
Nymphaea odorata, 121.

Oak, 60; Black, 61; Scrub, 60; White, 61.
Occurrence of Catharinaea crispa in Maine, 74.
Ocimum, 44.
Odontella aurita, 138; turgida, 138.
Odontochisma denudatum, 73.
Odontidium Harrisonii, 137; hiemale, 137; mutabile, 137.
Oedogonium, 78.
Oenothera biennis, 122.
Older Types of North American Violets, — I, 93.
Omphalodes Luciliae, 39.
Onobrychus eubrychidea, 43.
Onoclea, 85; sensibilis, 85; Struthiopteris, 85.
Ophioglossaceae, 85.
Ophioglossum, 85; vulgatum, 85.
Opulaster, 54.
Orange, Osage, 91, 148.
Orchidaceae, 52.
Ornithogalum, 43; Boucheanum, 43; undulatum, 43.
Orobanche artemisiae, 49; artemisiepiphyta, 49; Columbriae, 49; columbarihaerens, 49; Rapum, 49; sarothamnophyta, 49.
Orontium aquaticum, 119.
Osage Orange, 91, 148; The Scientific Name of the, 91.
Osmunda, 85; cinnamomea, 85, var. frondosa, 85; Claytoniana, 85; regalis, 85.
Oxalis Acetosella, 207, var. subpurpurascens, 207; corniculata, 121.
Oxyria digyna, 154, 160.
Oxytropis, 54; campestris, var. johannensis, 162.

Pachycladae, 37.
Palmae, 37.
Palmellococcus, 197; miniatus, 198.

Panax nossibiensis, 43.
Panicularia, 53.
Panicum tennesseense, 208; Werneri, 208.
Papaver Rhoeas, 39.
Paralia sulcata, 140.
Parietales, 37.
Parnassia Kotzebuei, 162, 167; parviflora, 162, 189.
Pease, A. S., Alpine Variety of Houstonia caerulea, 209.
Pedicularis flammea, 163.
Pelargonium zonale, 41.
Pellaea atropurpurea, 187; gracilis, 74, 154.
Penium, 227; annulare 228, 233, var. obesum, 233; Clevei, 228, 230, var. crassum, 230; closterioides, 228, forma interrupta, 229; cruciferum, 228, 232; curtum, 228, 232; cuticulare, 228, 230; Libellula, 228, var. intermedium, 229; var. interruptum, 229; margaritaceum, 228–230, var. punctatum, 231; minutum, 228, 232, 233, var. elongatum, 233; Navicula, 228, 229; New England Species of, 227; phymatosporum, 228, 231; polymorphum, 228, 231; spirostriolatum, 228, 231, var. **apiculatum**, 231.
Pentagonia, 55.
Peponia, 52.
Peponium, 52.
Peridermium, 194, 195; Cerebrum, 194; pyriforme, 194, and its probable alternate Host, 194.
Periptera tetracladia, 139.
Petasites trigonophylla, 155, 164, 191; vitifolia, 155, 164.
Peyrousea, 38.
Phaecocephalum, 51.
Phaseolus perennis, 10.
Phegopteris, 82; alpestris, 155, 158; Dryopteris, 63, 82; hexagonoptera, 82, 208; polypodioides, 82; Robertiana, 158.
Phelps, O. P., Noteworthy Plants of Salisbury, Connecticut, 74.
Phleum alpinum, 24, 154, 158, 190.
Phragmopedilum caudatum, 50.
Phrynium, 53.
Phyllantheae, 37.
Phyllanthus, 37, 45.
Phyllodoce caerulea, 163, 169, 190.
Physaloides, 55.
Physocarpus, 54.
Physospermum, 42.
Phyteuma Halleri, 39.
Picea, Abies, forma **virgata**, 110; alba, 75; brevifolia, 109, var. semiprostrata, 110; canadensis, 158, 169; excelsa, var. virgata, 110; mariana, 110, 158, 169, 174, var. brevifolia, 109, 110; nigra, 75, 218, var. brevifolia, 109, var. virgata, 110, rubens, 110; rubra, 110, forma **virgata**, 110, 111.
Pilea, 54.
Pinaceae, 157.
Pinguicula, 153; vulgaris, 154, 163, 167, 172, 183, 190.
Pink-petaled Form of Cethra alnifolia, 195.
Pinnularia, 131.
Pinus rigida, 194, 195; virginiana, 195.
Plagiogramma Gregorianum, 138; staurophorum, 138; validum, 138.
Plagiotropis vitrea, 135.
Plant, Is Rhinanthus Crista-galli an introduced, 26.
Plantago aristata, 122.
Plants collected at Roque Bluffs, Maine, in 1907, 218; from Maine, Three, 202; International Rules for Botanical Nomenclature chiefly of Vascular, 33; New Stations for two Vermont, 227; Newly observed Stations for Massachusetts, 11; Notes on Connecticut, 10; of Chesterville, Maine, Notes on, 207; of Salisbury, Connecticut, 74; Preliminary Lists of New England,— XX, Sparganiaceae, 86; Soil Preferences of certain alpine and subalpine, 149.
Platanthera, 53.
Pleiostylae, 37.
Pleuripetalum, 52.
Pleurococcus **marinus**, 197, 198; miniatus, 198.
Pleurolobus, 54.
Pleuropetalum, 52.
Pleurosigma, 128–130; acuminatum, 134; affine, 130, 134; americanum, 129, 134; angulatum, 130, 134, var. aestuarii, 134; attenuatum, 134; balticum, 128–130, 134; Brebissonii, 134; decorum, 129; 134; elongatum, 129, 134, var. gracile, 134; eximeum, 134; fasciola, 134; formosum, 134; hypocampus, 134; intermedium, 130, 134; latum, 134; littorale, 134; naviculaceum, 134; nebecula, 134; paradoxum, 129, 134; scalproides, 134; simile, 134; Spencerii, 134, var. curvulum, 134; strigile, 129, 134, 234; strigosum, 134;

subsalinum 135; Terryanum, 129, 134, Wansbeckii, 134.
Pleurostauron acutum, 134.
Pleurotaenium, 101; acutum, 126; constrictum, 101, 102, 105, 106; coronatum, 102, 106, var. fluctuatum, 102, var. nodulosum, 102; Ehrenbergii, 102, 103, 106, var. elongatum, 103, var. undulatum, 103; indicum, 104; maximum, 102, 104; nodosum, 101, 102, 105, 106; rectum, 104; subgeorgicum, 102, 104, 106; Synopsis of the New England Species of, 101; Trabecula, 102, 103, 106, forma clavatum, 104, forma granulatum, 104, var. rectum, 104; truncatum, 102, 103, 106; verrucosum, 101, 102, 105, 106.
Pneumaria, 55.
Poa, 157; alpina, 159; laxa, 156, 159, 166; Sandbergii, 159.
Podocystis adriatica, 137; americana, 137.
Podosira dubia, 140.
Podostemon ceratophyllus, 220, in Vermont, Rediscovery of, 220.
Polanisia trachysperma, 75.
Polemonium Van Bruntiae, 75.
Polygala Nuttallii, 121; polygama, 121.
Polygonaceae, 37.
Polygonales, 37.
Polygonastrum, 53.
Polygonum acre, 119; arifolium, 121; Careyi, 119; dumetorum, var. scandens, 119; hydropiperoides, 119; pennsylvanicum, 121; Persicaria, 121; punctatum, 121; sagittatum, 121; viviparum, 154, 156.
Polymnia, 62, 63; canadensis, 62.
Polypodiaceae, 82.
Polypodium, 82; vulgare, 82.
Polystichum, 83, 174; acrostichoides, 83, var. incanum, 83, Schweinitzii, 83; Braunii, 154; Lonchitis, 158, 190; scopulinum, 158, 167, 174, 188.
Polytrichum, 64; gracile, 64, in Maine, 64.
Pongelion, 54.
Pontederia cordata, 121, var. lancifolia, 121.
Portulaca, 50.
Portulacaceae, 50.
Potamogeton lucens, var. connecticutensis, 74; praelongus, 63.
Potentilla fruticosa, 12; nivea, 162; palustris, 162, 189; Robbinsiana, 162; tridentata, 156. 162, 169.
Preferences of certain alpine and subalpine Plants, Soil, 149.
Preliminary Lists of New England Plants,—XX, Sparganiaceae, 86.
Prenanthes Boottii, 154. 156, 164, 166; trifoliolata, var. nana, 164, 169, 171, 191.
Primula americana, 16; denticulata, 47; erosa, 47; farinosa, 15, in northeastern America, Variations of, 15, subsp. eufarinosa, var. genuina, 15, var. americana, 15, var. **incana**, 16, var. **macropoda**, 16, 163, 167, 217, on the Maine Coast, 217; incana, 16; mistassinica, 163, 167, 172.
Primularia cashmiriana, 47.
Protococcus miniatus, 198.
Pseudinga, 37.
Pseudoauliscus radiatus, 139.
Pseudoeunotia flexuosa, 138, bicapitata, 138; lunaris, 138.
Pseudofumaria, 54.
Psilosanthus, 55.
Pteridophyta, 36, 152, 157, 187.
Pteris, 82; aquilina, 82.
Pteropsiella, 68.
Purple Raspberry, 5.
Pycnanthemum, 55.
Pyrola grandiflora, 24, 162, 190; minor, 154.
Pyrus, 202; americana, 63, 203; **americana × arbutifolia**, 202.
Pyxilla baltica, 139.

Quebec and New Hampshire, The Alpine Rhinanthus of, 23.
Quercus ilicifolia, 60, 61; prinoides, 60, 61, var. **rufescens**, 61; Prinus, 12.
Quisqualis, 51.

Racomitrum lanuginosum, 173.
Radix, 51.
Ramondia, 38.
Rand, E. L., Arceuthobium pusillum at Mt. Desert, 75.
Rangeley Region, Arceuthobium, in the, 28.
Ranunculus acris, subsp. Friesianus, 40; Allenii, 161, 167; Boreauanus, 39; pygmaeus, 161, 167.
Raphanistrum Raphanistrum, 51.
Raphoneis amphiceros, 137; belgica, 137, var. intermedia, 137; gemmifera, 137; Surirella, 138.
Raspberry, Black, 4; Flowering, 5; Purple, 5; Red, 4, Sow-teat, 5.
Razoumowskia, 54.
Reboulia hemisphaerica, 73.
Record of Color Varieties of Gratiola at Westfield, a clerical Error, 195.

Red Algae, 90; Currant, 1; Raspberry, 4; Spruce, 109.
Rediscovery of Podostemon ceratophyllus in Vermont, 220.
Rehder, A., Quercus prinoides Willd., var. rufescens, n. var. 60; Some new or little known Forms of New England Trees, 109.
Reports on the Flora of the Boston District,— I, 81.
Retrograde Color Varieties of Gratiola aurea, 122.
Reynolds, E. S., The Flora of the great Swamp of Rhode Island, 117.
Rhabdonema adriaticum, 138; arcuatum, 138.
Rhamnus alnifolia, 162, 189.
Rhaponticum, 48; subgen. Alfredia, 48.
Rhexia virginica, 120.
Rhinanthus, 24, 26; Crista-galli, 23–26, an introduced Plant? 26; minor, 23; **oblongifolius**, 24, 25, 163, 166, 190; of Quebec and New Hampshire, The alpine, 23.
Rhizoclonium, 200.
Rhizosolenia styliformis, 138.
Rhode Island, Flora of the great Swamp of, 117.
Rhododendron, 187; canadense, 162, 187, 189; lapponicum, 162, 169, 174, 182; maximum, 120, 187; nudiflorum, 122; Rhodora, 187.
Rhoiconeis trinodis, 134.
Rhoicosphaenia curvata, 136.
Rhus copallina, 121; glabra, var. laciniata, 115; hirta, 115, var. laciniata, 115; typhina, 115, forma **dissecta**, 115, forma laciniata, 115, var. laciniata, 115.
Rhynchospora, 53; capillacea, 159, 189; fusca, 119; macrostachya, 119.
Ribes albinervium, 3, 4; lacustre, 63; oxyacanthoides, 63, 181, var. calcicola, 2; rubrum, 1, 3, var. sativum, 3, var. subglandulosum, 3; tristre, 3, var. **albinervium**, 4; vulgare, 1, 3, and its indigenous Representatives in eastern North America, 1.
Riccardia latifrons, 66; palmata, 73; sinuata, 73.
Riccia, 56; canaliculata, 56; fluitans, 56, var. Sullivantii, 56; Huebeneriana, 56; Sullivantii, 56.
Ricciella, 56, 57; crystallina, 57; fluitans, 57; **Sullivantii**, 56, 57.
Riddle, L. W., Notothylas orbicularis in Massachusetts, 219.
Robinson, B. L., Maclura pomifera (Raf.) Schneider, 148; The scientific Name of the Osage Orange, 91.
Roestelia, 195.
Roque Bluffs, Maine, in 1907, Noteworthy Plants collected at, 218.
Rosa, 37; Beatricis, 39; glutinosa, var. leioclada, 40; Jundzillii, var. leioclada, 40; villosa, 50.
Rosaceae, 37, 78.
Rubi, 4; Connecticut, 4.
Rubia, 52.
Rubus, 52; alleghaniensis, 5, 6; Andrewsianus, 6, 10; arcticus, 24, 162, 169, 189, 190; **ascendens**, 9; Baileyanus, 6; canadensis, 6, 10; castoris, 162; Chamaemorus, 150–152, 157, 162, 166, 177, 180, 181, 218, 219; cuneifolius, 5; floricomus, 6; frondosus, 6; hispidus, 10; invisus, 6; neglectus, 5; nigricans, 8; nigrobaccus, 5, var. Gravesii, 6; occidentalis, 4, 5, × strigosus, 5; odoratus, 5; pergratus, 10; procumbens, 6, 8; recurvans, 6, 8; **Rossbergianus**, 7; semisetosus, 8, 10; setosus, 8, 9; strigosus, 4, 5; subuniflorus, 6; triflorus, 5, 162, 169, 190.
Rules for Botanical Nomenclature chiefly of Vascular Plants, International, 33; of Botanical Nomenclature adopted by the Vienna Congress, On the, 29.
Rumex, 37.
Rumicoideae, 37.
Rynchospora, see Rhynchospera.

Sabbatia campestris, 207; chloroides, 14, 119.
Sagina saginoides, 161, 167.
Sagittaria Engelmanniana, 121; latifolia, 121.
Salicaceae, 37.
Salicornia, 200, 204; annua, 204; europaea, 204–206, and its Representative in eastern America, 204, var. fruticosa, 204, var. herbacea, 204, var. **pachystachya**, 206, var. **prostrata**, 206, fruticosa, 205; herbacea, 204–206, var. pachystachya, 205, 206; var. prostrata, 206; prostrata, 205, 206; rubra, 206; sempervirens, 204.
Salisbury, Connecticut, Noteworthy Plants of, 74.
Salix, 37, 157; adenophylla, 225, 226; amplifolia, 222; argyrocarpa, 24, 154, 160, 166, 190; aurita × caprea,

41; aurita × cinerea × repens, 42; balsamifera, 156, 160, 189; Barclayi, 160, 190; 221; Barrattiana, 226; candida, 179; caprea × daphnoides, var. pulchra, 42; × capreola, 41; chlorolepis, 160, 167; coactilis, 203, 204; **coactilis × cordata**, 203; cordata, 203, 204, 224, 226; desertorum, 155, 160, 167, var. stricta, 160; fuscescens, 221, 224, var. **hebecarpa**, 224; glauca, 160, 172, 190; glaucophylla, 222, 224; herbacea, 160, 166; **laurentiana**, 221, 222; lucida, var. intonsa, 222; myrtilloides, 224; **obtusata**, 223; pedicellaris, 160, 189, 224; pellita, 222, 224; phylicifolia, 153, 154, 156, 160, 166, 190; pseudomyrsinites, 160, 189, 190, 221; pyrolaefolia, 223, 224; Richardsoni, var. Macouniana, 221; rostrata, 222, var. **luxurians**, 223; speciosa, 226; ×Straehleri, 42; **syrticola**, 225, 226; Uva-ursi, 154, 156, 160, 166; vestita, 24, 160, 172, 190.
Salsola linearis, 142, 143, 145, 146; maritima, 144, 146; salsa, 142, 143, 146, var. americana, 143, 144, 146.
Saltwort, 204.
Salvia oxyodon, 42.
Samphire, 204.
Saponaria, sect. Vaccaria, 48.
Sarcoscyphus Ehrharti, var. erythrorhizos, 57; sphacelatus, var. medius, 57; Sullivantii, 57.
Sarracenia purpurea, 120.
Satyrium, 48.
Savastana, 53.
Savia, 54.
Saxifraga aizoides, 154, 161, 167, 172; Aizoön, 154, 161, 166, 172; aspera, subsp. aspera, 47; autumnalis, 154; caespitosa, 162, 183; nivalis, 161; oppositifolia, 154, 161, 166, 172, 183, 185; rivularis, 154, 155, 161; stellaris, var. comosa, 155, 161.
Saxifrages, 153, 154.
Scabiosa Olgae, 39.
Scandalida, 54.
Scandix Pecten, 39; Pecten-Veneris, 39.
Scapania apiculata, 71; glaucocephala, 72; umbrosa, 71.
Scheuchzeria palustris, 207.
Schizonema crucigerum, 135; viridulum, 135.
Schizonotus, 54.
Schneider, E. S., Acanthospermum australe at Lawrence, Massachusetts, 26.
Schoberia maritima, 144.
Schrebera, 50.
Sciadophyllum heterotrichum, 43.
Scientific Name of the Osage Orange, 91.
Scirpus, 220; caespitosus, 156, 159, 189, 190; Olneyi, A new Variety of, 220, var. **contortus**, 220; pauciflorus, 159, 189.
Scoliopleura, 126, 128, 130; latestriata, 135, var. Amphora, 135; tumida, 135.
Scoria, 53.
Scribner, F. Lamson, Notes on Muhlenbergia, 17.
Scrophularia leporella, 14; marilandica, 14.
Scrub Oak, 60.
Scutellaria lateriflora, 122; parvula, 75.
Seaweeds, 91.
Sebastiano-Schaueria, 51.
Selaginella selaginoides, 158, 170, 174, 189, 190.
Senecio Balsamitae, 164, var. firmifolius, 164; discoideus, 164, 191; pauciflorus, 164, 191.
Shepherdia, 54, 179; canadensis, 162, 167, 172, 179.
Sibbaldia procumbens, 154, 162, 177, 178.
Silene acaulis, 161, 169.
Silybum, 55.
Simaruba, 45; amara, var. opaca, 45; laevis, 45.
Simarubaceae, 45.
Siphonocladus, 200.
Sisymbrium altissimum, 227.
Sium cicutaefolium, 122.
Skunk Spruce, 76.
Smilacina, 53; trifolia, 218.
Snake Spruce, 110.
Society, Bulletin of the Josselyn Botanical, 196, Meeting of the Josselyn Botanical, 107, 124.
Soil Preferences of certain alpine and subalpine Plants, 149.
Solidago, 157; ambigua, 164; bicolor, var. concolor, 164; decumbens, 155, 164, 167; macrophylla, 218, var. thyrsoidea, 164; multiradiata, 28, 164, 191; odora, 122; puberula, 122; sempervirens, 15; uliginosa, 122; Virgaurea, 154, var. alpina, 156, 164, 166.
Some new green Algae, 197; New or little known Forms of New England Trees, 109; New Willows of eastern America, 221.
Sophronanthe, 123.

Sorbaria, 54.
Sorrel, 154.
Sow-teat Raspberry, 5.
Sparganiaceae, Preliminary Lists of New England Plants,— XX, 86.
Sparganium affine, 89; americanum, 86, 87, 121, var. **androcladum**, 86, 87, var. Nuttallii, 87; androcladum, 87; angustifolium, 86, 87, 89; diversifolium, 86–89, var. **acaule**, 86–89, proles nanum, 88; eurycarpum, 86; fluctuans, 86, 87, 90; **lucidum**, 86, 87, 90; minimum, 86, 90; multipedunculatum, 89; nanum, 88; Nuttallii, 87; ramosum, 87; simplex, 86–90, var. acaule, 88, var. americanum, 87, var. angustifolium, 89, var. multipedunculatum, 89; var. Nuttallii, 87.
Spartium biflorum, 51.
Spathyema, 53.
Species of Penium, New England, 227; of Pleurotaenium, Synopsis of the New England, 101.
Spergularia, 54; arvensis, 121.
Spermatophyta, 152, 157, 187.
Sphagnum, 120, 183.
Sphenolobus exsectus, 71; minutus, 73.
Spiesia, 54.
Spina, 51.
Spiranthes, 53; gracilis, 121; Romanzoffiana, 207.
Spirulina, 131.
Sporobolus, 23.
Spruce, Black, 28, 208; Cat, 76; Red, 109; Skunk, 76; Snake, 110; Swamp, 75; White, 75, 76, 208.
Stachyotypus, 37.
Stachys § Stachyotypus, 41.
Staphylea, 49.
Staphylis, 49.
Statice sibirica, 155, 163, 167, 174, 186.
Stations for Chamaecyparis on Long Island, New York, New, 74; for two Vermont Plants, New, 227.
Stauroneis, 125, 126, 131; acuta, 126, 128, 134; gracilis, 134; Gregoryi, 134; nova, var. britanica, 126, 134; phoenicentron, 134; salina, 134; spicula, 134; Stodderi, 134; Terryi, 126, 134.
Stellaria borealis, 63.
Stenocladium, 17.
Stephanodiscus niagarae, 139.
Stephanopyxis appendiculata, var. intermedia, 139; corona, 139; ferox, 139; turris, 139, var. intermedia, 139.
Stipa, 44.
Streptanthus heterophyllus, 45.
Streptopus, 106; amplexifolius, 106, 107; oreopolus, 106, 107, A possible Hybrid, 106; roseus, 106, 107.
Strong, M. A., Further information regarding the Occurrence of Dryopteris Filix-mas in Vermont, 27.
Suaeda, 54, 140, 143, 144; **americana**, 146; in northeastern America, The Genus, 140, linearis, 141–146, var. ramosa, 143, 144, 146; maritima, 140–145, var. vulgaris, 144; microsperma, 145; **Richii**, 145, 219.
Subularia aquatica, 161.
Sueda, 146.
Sumach, 109.
Surirella, 127, 131; angusta, 137; biseriata, 136; cardinalis, 127, 137; constricta, 137; elegans, 127, 131, 136, var. norvegica, 136; fastuosa, 127 137, var. lata, 137; Febigerii, 128, 137; gemma, 137; gracilis, 127, 137; linearis, 136; Moelleriana, 137; nobilis, 131; ovalis, 137, var. angusta, 137; recedens, 137; robusta, 136; saxonica, 127; splendida, 127, 136; striatula, 127–130, 137, var. triplicata, 137; tenera, 127, 136; Terryi, 127, 137.
Swamp of Rhode Island, The Flora of the great, 117; Spruce, 75.
Symplocarpus, 53.
Syndendrium diadema, 139.
Synedra affinis, 137; danica, 137; pulchella, 137, var. Smithii, 137; superba, 137; ulna, var. danica, 137.
Synopsis of the New England species of Pleurotaenium, 101.

Tabellaria flocculosa, 138; fenestrata, 138.
Tamus, 49.
Tapeianthus, 43, 50.
Taraxacum, 55; ceratophorum, 164, 191.
Tephrosia, 54.
Terpsinoe americana, 138; musica, 188.
Terry, W. A., Causes of Variation in Color of some red Algae, 90; A partial List of Connecticut Diatoms with some account of their Distribution in certain Parts of the State, 125.
Tetragonanthus, 55.
Tetragonolobus, 48, 54; Scandalida, 48; siliquosus, 48.
Thalictrum alpinum, 161.
Thamnos, 49.
Thirteenth Annual Field Meeting of

the Vermont Botanical and Bird Clubs, 108; Annual Meeting of the Josselyn Botanical Society, 107.
Thistle, Blessed, 28.
Three Plants from Maine, 202.
Thuspeinata, 43, 50.
Thymus Serpyllum, var. angustifolius, 40.
Tillaea, 49.
Tillia, 49.
Tissa, 54.
Tofieldia glutinosa, 160, 172, 189; palustris, 160.
Torresia, 53.
Tovaria, 53.
Toxylon, 54; aurantiacum, 91; Maclura, 91; pomiferum, 91.
Tragus, 53.
Trees, Some new or little known Forms of New England, 109.
Triceratium, 130; alternans, 139; flavum, 139.
Trichochloa, 17, 18; foliosa, 19; glomerata, 22; longiseta, 18; mexicana, 18; sobolifera, 18.
Trichochloa § Acroxis, 18; § Stenocladium, 17.
Tricoccae, 37.
Trichilia alata, 50; pterophylla, 50.
Trifoliastrum, 37.
Trifolium hybridum, 121.
Trillium cernuum, 121; undulatum, 121.
Triodon, 53.
Trisetum melicoideum, 159.
Tristegineae, 50.
Tristegis, 50.
Tropidoneis seriata, 135; zebra, 135.
Tuber, 51; cibarium, 51.
Tuberaria, 46.
Tubiflorae, 37.

Ubochea, 38.
Umbelliferae, 37.
Unifolium, 53.
Uromyces Fabae, 39.
Uropedium, 50.
Urticaceae, 37.
Urticales, 37.
Urticastrum, 54.
Urvillea, 38, 52.
Utricularia biflora, 119; clandestina, 119; cornuta, 119; gibba, 119; inflata, 119; intermedia, 119; resupinata, 119; subulata, 119.

Vaccinium, 187; atrococcum, 119; caespitosum, 154, 156, 163, 190; canadense, 75, 156, 163, 169, 189; ovalifolium, 163, 177, 178, 188, 190, 191; Oxycoccus, 163, 190, 218; pallidum, 119; pennsylvanicum, 181, 187, var. angustifolium, 156, 163; uliginosum, 154, 156, 163, 169, 174, 177, 182, 190; Vitis-Idaea, 181, var. minus, 156, 163, 169, 170, 177, 189, 191.
Vagnera, 53.
Valentinia, 53.
Valeriana sylvatica, 163, 190; uliginosa, 163.
Variations of Primula farinosa in northeastern America, 15.
Varieties of Gratiola at Westfield, a clerical Error, Record of Color, 195; of Gratiola aurea, The retrograde Color, 122.
Variety of Houstonia caerulea, Alpine, 209; of Scirpus Olneyi, A new, 220.
Vaucheria, 200; **Gardneri**, 201, 202, forma **tenuis**, 201; geminata, 201, 202; **longipes**, 201, 202.
Verbena hastata, 122.
Vermont Botanical and Bird Clubs, 108; Further Information regarding the Occurrence of Dryopteris Filix-mas in, 27; Plants, New Stations for two, 227; Rediscovery of Podostemon ceratophyllus in, 220.
Vernonia, 55; noveboracensis, 122.
Veronica alpina, 25, 154, var. unalaschcensis, 24, 163, 166, 190; Anagallis, 39; Anagallis-aquatica, 39.
Viburnum cassinoides, 122; dentatum, 122; pauciflorum, 154, 163, 169, 190.
Vienna Congress, On the Rules of Botanical Nomenclature adopted by the, 29.
Vincetoxicum 49; nivale, 43.
Viola, 93, 151; affinis, 93, 94; arenaria, 13; asarifolia, 95, 96; blanda, 93; canina, var. Muhlenbergii, 151, 162; carolina, 96, 97; conspersa, 151, 162; cordifolia, 98; cucullata, 93, 94; cuspidata, 96; Dicksonii, 96; fimbriatula, 96; **hirsutula**, 98, 211–213, 215; **hirsutula × papilionacea**, 98, 211, 213, 214; hirta, 41; labradorica, 162; laetecaerulea, 96; Mendel's Law of Dominance in the Hybrids of, 211; nephrophylla, 162, 189, 216; nodosa, 96; obliqua, 93, 94; palmata, var. dilatata, 96; palustris, 162; papilionacea, 93, 94, 96, 98, 211–213, 215, × villosa, 98; pedata, 121; rotundifolia, 93; sagittata, 13; sep-

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tentrionalis, 95; sororia, 94, 95, 98; tricolor, var. hirta, 41; villosa, 95–98, var. cordata, 98, var. cordifolia, 95, 98.
Violets, The older Types of North American,— I, 93.
Vitis Idaea, 154.
Volvulus, 55.

Wahlenbergia, 48.
Ware, R. A., Reports on the Flora of the Boston District,— I, 81.
Weed, Mormon, 26.
Weigelas, 147.
Westfield, a clerical Error, Record of Color Varieties of Gratiola at, 195.
Westford, Massachusetts, Alchemilla pratensis found at, 92.
Wheeler, L. A., New Stations for two Vermont Plants, 227.
White Oak, 61; Spruce, 75, 76, 208.
Wickstroemia, 49.
Willows, 221; of eastern America, Some new, 221.
Willugbaeya, 55.
Witches' Brooms, 28, 75.
Woodsia, 85; alpina, 154, 158, 166, 172; glabella, 154, 158, 166, 172; ilvensis, 85; obtusa, 85; oregana, 158; scopulina, 158.
Woodward, R. W., Notes on Connecticut Plants, 10.
Woodwardia, 82; augustifolia, 82; areolata, 82, 83; virginica, 82, 124.
Wormia, 47.

Xyris caroliniana, 119, 120; flexuosa, 120, 121.

Zatarhendi, 44.
Zygadenus, 193; chloranthus, 160, 170.